by C. H. RIDGE

STAGE LIGHTING

THIS is not merely a textbook for theatre electricians. It is much more than that. Besides being indispensable to producers and scene-designers, it is also a book for everybody who is intelligently interested in the theatre. The photographs with which the book is illustrated are in themselves a record of some of the most modern methods of stage-craft practised in England. While the professional worker in the theatre will find in these pages the results of the latest scientific experiments in lighting, much of the book should also prove of the greatest use to amateurs working on quite modest lines, as the author begins with the first principles of his subject.

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Designed and Produced by Herbert M. Prentice.
[See p. 175.]

Scene : St. James' Park.
From THE PROVOK'D WIFE.
By Sir John Vanbrugh.

From an Autochrome.
Scott & Wilkinson, Cambridge.
Festival Theatre, Cambridge.

STAGE LIGHTING

BY

C. HAROLD RIDGE,
A.R.S.M., D.I.C., etc.

WITH A PREFACE BY
NORMAN MARSHALL

BOSTON AND NEW YORK
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Acknowledgments

I WISH to thank my friends Mr. Terence Gray and Mr. Norman Marshall for their invaluable help in the preparation of this book. I am also greatly indebted to Mr. Edward Maufe, Mr. Frank Thomas and Miss Jocelyn Hughes for drawings. Mr. Lester Groom of the General Electric Co., Mr. Walter Veness of ReandcO, and the Strand Electric Co., have all given valuable advice, and material help in the loan of blocks. The jacket design is by Miss Doria Paston of the Festival Theatre.

C. H. R.

PRINTED IN ENGLAND

Preface

Let us be frank about it. This is really a most alarming looking book. Not, of course, if you are an electrician, but this preface is not for electricians. Anyway, they certainly will not pause to read it; they will be far too eager to scurry on to the first chapter and plunge as joyously as Mr. Ridge straight into the sea of technicalities which compose the early chapters. But this is not just a book for electricians. It is just as much a book for you who have no strong feelings about cone-electrodes and metallic resistances, who perhaps have never even heard of a bus bar, and gaze with mild embarrassment at these bewildering diagrams of outlandish apparatus.

Naturally there is much in the following pages which only concerns the practical electrician, yet this is just as much a book for producers and scene-designers as it is a text-book for theatre electricians. I will go further and say that this is a book which should be read by everybody who is intelligently interested in the theatre.

No art suffers so badly as the theatre from utterly uninformed criticism. Musicians, painters and authors can all rely on at least a reasonable proportion of their audience having some technical appreciation of music, painting and writing. Even elementary schoolchildren are now taught the rudiments of an intelligent appreciation of these arts, but intelligent appreciation of the art of the theatre has as yet hardly begun to exist. Dramatic criticism confines itself to discussing the work of the author alone, with perhaps three or four lines of perfunctory praise or blame for producer, actor and designer. In other words, so-called dramatic criticism is at present in all essentials really *literary* criticism.

It is unfair to blame the critics themselves for this state of affairs. They would willingly concern themseves a little more with the art of the theatre as a whole if they were allowed a little more elbow room. But a newspaper will take more notice of you if you knock down a lamp-post in your motor car than if you write or produce a notable play. Besides, nearly all editors are obsessed by the idea that people enjoy reading a detailed account of the plot of a play (although personally I have never found anybody who found this anything but tedious) so that the amount of space left to the average critic for actual criticism is so small that obviously one can hardly blame him for not attempting to write a critique which considers the work of the author in conjunction with the work of his collaborators, such as the producer, the actors, and the designer, and is therefore genuine *theatrical* criticism.

Perhaps you are beginning to wonder what on earth all this has to do with Mr. Ridge's book, but what I am driving at is that no art can flourish without intelligent criticism, and that in England, criticism of the art of the theatre is almost entirely confined to one branch of it—the playwright's. There is nothing more utterly disheartening to a producer, an actor, a designer, or a technical director than to be forced to put on the stage a piece of work which he knows to be unsatisfactory and then to discover that nobody notices that it is bad. When this happens nearly all the incentive to really fine work is taken away. That is why I, as a worker in the theatre, am so anxious that Mr. Ridge's book (apart from the purely technical chapters) should be read by everybody who is intelligently interested in the art of the theatre. This book sets up a standard for the sort of stagecraft which you in the audience have a right to demand from the theatre, whether large or small, professional or amateur. The crying need of the English theatre at the moment is for theatrically educated audiences, audiences who have some theoretical knowledge of the various branches of the art of the

theatre, who will not tolerate work which does not come up to the standard which they know they have a right to expect, and who will demand that their theatrical fare includes a reasonable proportion of plays which give opportunity for the practice of the art of the theatre in all its branches. Any theatre-goer who reads the later chapters of this book will bring to the theatre a new and understanding interest in the whole question of modern stagecraft.

The mere fact that this book has been written is in itself an immensely encouraging sign of the times. Five years ago, nobody in his senses would have imagined that there was a public for a book of this sort. I do not suppose that Mr. Ridge himself would have thought it worth his while writing this book had it not been for the success of *Stage Lighting for Little Theatres*, an earlier and much smaller book of his, published three years ago, which dealt with the subject of lighting from the point of view of the amateur and "Little" theatre worker. There are portions of the present book, the result of the most painstaking experiment and research, which are contributions of the greatest importance to the science of stage lighting in its most advanced and elaborate form, but the fact remains that it was the interest and enthusiasm of the workers in the amateur theatre which made this book possible. Here we have what I think will readily be acknowledged as the standard text-book on the subject, as important and necessary to the amateur working in a small parish hall as it is to the professional who works in a theatre equipped with all the amazing resources of the most modern systems of lighting. My point is that we of the professional theatre owe this book to the amateur.

I am one of those who believe that the future of the English theatre is in the hands of the amateurs. So many people have made this beautifully vague statement with such very different ideas in their mind that I had better explain myself a little more definitely. At present there is a danger that the amateur theatre

may become positively smug as a result of the way it is being pampered and flattered. For instance, many people talk and write as if sincerity was the monopoly of the amateurs. The assumption is, of course, a preposterous one, and anybody like myself who has produced with a professional repertory company and owed as much as I have to their amazing enthusiasm and devotion to their art, to their almost unbelievable capacity for unceasingly arduous and self-sacrificing work, cannot but resent such a suggestion very strongly indeed. Nor do I think that amateur acting and producing will ever, except in a few isolated instances, equal the professional standard. It is utterly unreasonable and illogical to expect it to do so. Naturally one has the very greatest respect for the work amateur companies are doing in providing drama in small towns and villages which would otherwise be in a state of theatrical barbarism, and in supplementing with intelligent plays the work of the professional theatre in large towns, but it is not of this that I am thinking when I say that I believe that the future of the English theatre is in the hands of the amateurs. What I have in mind is the way the development of the amateur movement is providing the professional theatre with a theatrically educated audience, an audience with practical experience and understanding of the various arts of the theatre, an audience which is genuinely and critically appreciative of good work, and rightly intolerant of slovenly and old-fashioned methods which until a year or two ago would have been unnoticed by all but a very few. I am convinced that in a few years the intelligent development of the amateur movement will have a revolutionary effect on the methods of the professional theatre. Audiences are already becoming keenly critical of the antiquated stage-craft and lighting which still prevail in many theatres. With half-a-dozen large biscuit tins, a few electric bulbs and some sheets of coloured gelatine, the intelligent amateur who has studied the subject of lighting can get far finer results than is possible with

the inflexible and out-dated lighting equipment of the old-fashioned professional theatre. As a result the amateur naturally refuses to put up with unintelligent lighting when he goes to the theatre himself. Recently in a West End theatre I heard the audience openly laugh at a stupid piece of lighting which a year or two ago would have been completely unnoticed.

On the other hand, there is still a large section of the amateur theatre which has not yet realised the tremendous possibilities of lighting as an aid towards the production of plays requiring a special "atmosphere" and plays depending to some extent on the appeal to the eye by means of settings and costumes. Far too many amateur companies timidly persist in producing an endless succession of efficient little plays set in kitchens and attics to the exclusion of all plays of a more imaginative type which call for the practice of the art of the theatre in all its branches. It is to be hoped that Mr. Ridge's book will inspire at least some of these unenterprising companies to launch out upon plays depending more upon the appeal to the imagination through colour and form than upon the photographic reproduction of those parochial trivialities with which all but the very best of the kitchen and parlour plays are concerned.

At this point, I know, some of you will begin to regard me with profound distrust as one of those people who forget that "the play is the thing." Of course it is. But the play does not simply consist of the author's words repeated parrotwise by the actors. A play in the theatre is the result of a collaboration between playwright, producer, actor, designer, technical director, musician and dancer—though naturally all plays do not require the help of the last two. I have no quarrel with the purely realistic drama of writers like Maughan Coward, and Lonsdale. On the contrary, I am convinced that it is the most perfect form of expression for a very large number of dramatic themes. But the theatre cannot exist solely upon such fare. In

England this kind of writing has now been brought to the highest pitch of efficiency, and unless our drama is prepared to advance and develop along new lines—although still relying to a large extent on the purely realistic play—the result will inevitably be stagnation. I believe that Flecker's "Hassan" is a good example of the type of play towards which the English theatre will advance. Here is a play which utilises with superb assurance every resource of the modern theatre and offers magnificent opportunities to each of the collaborators in the art of production whom I have enumerated above. At the same time it is the play of a poet, a play in which the actual lines matter tremendously. Finally, it is an actor's play, a play in which the actor is treated royally by the author. Altogether, "Hassan," in spite of its obvious imperfections, is a crushing retort to those sneers about "mere spectacle" with which every attempt to use modern stagecraft in England is greeted. Admittedly there are few plays like "Hassan," but that is no reason why every effort should not be made to develop new methods of stagecraft. I have heard it said of Mr. Ridge and his colleagues that they are putting the cart before the horse,experimenting in methods of stagecraft for which the plays have not yet been written. The answer to that is that no dramatist who desires his plays to be performed will write for a kind of theatre which does not exist. In the past it has always been the changing design and equipment of the theatres which has governed the form in which plays have been written. To borrow an analogy from another art, no composer will write music for an instrument which does not exist, but as soon as a new instrument is perfected, composers will at once make use of it.

I am, of course, perfectly well aware that there is a very great danger that in the wrong hands an elaborate modern lighting plant may be so misused that the play is merely regarded as the excuse for a firework display. However, if there is anybody who doubts that

Mr. Ridge the electrician is always subordinated to Mr. Ridge the artist, let him turn to the beginning of Chapter VIII and read how vehemently Mr. Ridge denounces the crime of putting on a bad play just because it lends itself to spectacular effects. In fact, Mr. Ridge the artist values stage lighting so highly that he hates to see it wasted on an unworthy play, just as much as a connoisseur hates to give his best wine to unworthy company. It was as an actor that Mr. Ridge was first apprenticed to the theatre, which is perhaps the reason why he understands so well that all theories of lighting must be based on the principle that the first duty of good stage lighting is to help the actor. It has been my privilege to work with Mr. Ridge on several productions, and much of the lighting which has pleased him most was entirely unnoticed by the majority of the audience because it was so much part of the production. I have seen lighting which was sensationally beautiful but criminally selfish, because all the time it was fighting against the actor, calling attention to its own beauty instead of to the faces of the actors. It is easy enough to light a scene so that the actors' faces are clearly visible—an absolute essential except in the briefest scenes; it is not difficult to light a scene for "atmosphere" and pictorial effectiveness; the real test of good stage lighting is the extent to which it succeeds in combining these two principles.

NORMAN MARSHALL.

June, 1928.

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Chapter I

TECHNICAL STAGE TERMS

It is a pity that the terms in general use among theatrical people are not more commonly used by Little Theatre workers and others. A knowledge of correct technical terms saves time and much misunderstanding.

1. The Stage. This is the whole area behind the proscenium, but should any portion project in front of it, it is known as a *fore-stage*, or *apron-stage*. The portion of the stage upon which the actors move and speak is called the *acting-area*. The back of the stage is spoken of as *up-stage*, and the front is called *down-stage*. The terms right and left are usually applied to the acting-area when looking towards the audience. Terms such as *centre*, *right centre*, *left centre*, *down centre*, explain themselves. A general name for the space at the sides beyond the acting-area is the *wings*, sometimes particularised as the *prompt wings or O.P. wings* (O.P. = opposite prompt). The terms *prompt* and *O.P.* for the sides of the stage are gradually falling into disuse.

Various movable platforms which are built upon the stage to form terraces, a raised dais for a throne, or steps, are called *rostrums*. Low set-pieces forming walls, hedges and so on are known as *ground rows*. Rectangular wooden frames covered with canvas or other material, which stand upon the stage and reach as high as the audience can see, are termed *flats*. When joined together and used with doors and windows to form a room they constitute a *box scene*. Flats set at an angle down each side of the stage with an interval between are called *wings*. Flats and ground rows are supported by

braces. These are of wood or iron, having at one end a hook to engage with a screw-eye in the scenery, and at the other end a ring through which a *stage-screw* (or *knuckle*) is fixed into the floor. To avoid damaging the floor in this way, heavy weights may be used instead, on the stage end of the brace. The term *backing* is used for any piece of scenery used behind windows and doors and such like to prevent the audience seeing through to the stage walls. The wing shown in Fig. 1 is hinged to another known as a *return*. Any kind of narrow edging, such as six-inch board round door ways and window frames to represent the thickness of walls and so on, is called a *set-back*. Small openings in the stage closed by a wooden or metal flap and having an electric socket inside for connecting stage plugs, etc., is called a *dip*.

2. Above the Stage. Far above the stage and close under the roof is the *gridiron* or *grid*. This is a framework on which are mounted the pulley-wheels used in lowering and raising scenery and lights. The ropes passing over these pulleys are usually operated from a gallery on the side wall of the stage known as the *flies*. Sometimes the term is used loosely to refer to the whole upper regions of the theatre. Scenery suspended from the grid is said to be *flied*. When the grid is not high enough to allow scenery to be hauled straight up out of sight, it is customary to *tumble* it. By this method the bottom of a *cloth* may be hauled up as well as the top, it being kept from wrinkling by a free roller in the centre. With a grid too low even for this, the roller blind principle is the only alternative. Further particulars of these methods should be obtained from a book dealing exclusively with scenery. The principal objects of stage equipment suspended from the grid are:—

(a) *Back-cloths*. These are white or painted with a design or landscape. For the Little theatre it is better to keep to plain white, and use coloured lights, or to paint the cloth a plain colour, such as dark blue.

When the back-cloth is curved round so as to hide the

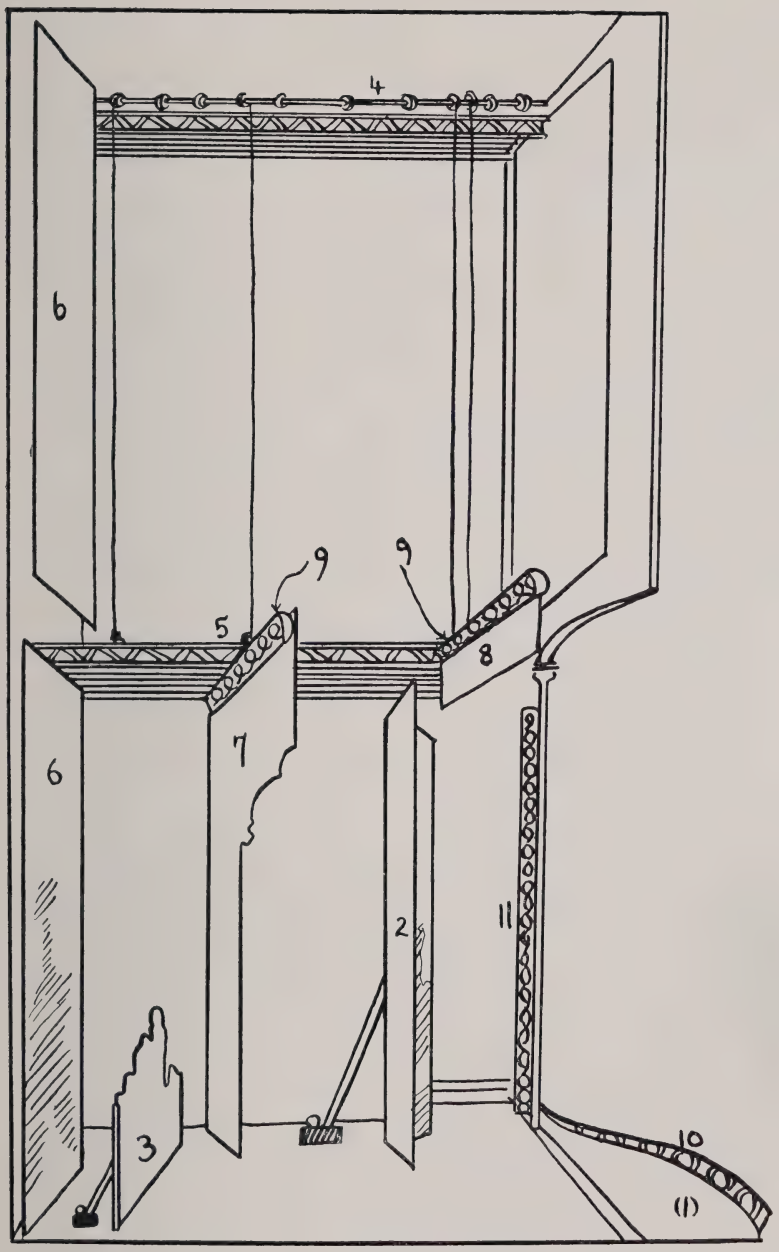


Fig. 1.

1. Apron stage. 2. Wing, supported by brace. 3. Ground row. 4. Grid. 5. Flies. 6. Back cloths. 7. Cut cloth. 8. Border. 9. Battens. 10. Floats. 11. Proscenium "length."

side walls as well as the back, it is known as a *cyclorama-cloth*, or *artificial horizon*. Many theatres are fitted with permanent plaster domes for use in open air scenes. Cycloramas extend sufficiently high to allow borders to be dispensed with. (See page 97.)

(b) *Battens*. Behind each border is suspended a long row of lights known as a batten. The batten nearest the audience is called the *concert batten*, or *No. 1 batten*. Battens used on the ground are sometimes named *ground battens*, or *lengths*. The *footlights* are more correctly named the *floats*, because originally they consisted of wicks floating in oil.

(c) *Borders*. These are strips of canvas two or three feet deep suspended horizontally across the stage to hide the upper parts from the audience. They are unsatisfactory and are used less and less every year.

(d) *Cut-cloths*. The cloths are used down stage, and may be cut to the form of arches, silhouette trees, etc. These naturally need some form of *backing*, and, used with or without ground rows, give an illusion of depth and distance.

(e) *Tabs*. The main curtains closing the proscenium opening are called *tableaux curtains* or *tabs*.

(f) *Tormentors*. These are borders suspended up and down stage at the sides, to prevent the side walls of the stage being seen above the side scenery. They are also a clumsy device. A reference to Fig. 1 will help to make the above clear. Wings used to mask-in to the proscenium and not part of the scene, are called *tormentor wings*.

3. Understage Machinery.

Bridges. Transverse sections of the stage capable of sinking below or rising above stage level. (See Fig. 48.) At one time made of wood and worked on the counter-weight system, they are now of girder or latticework design in steel and are worked on hydraulic rams or electrically.

Cuts. Any narrow transverse section of the stage capable of being opened. The only cut much used

to-day is the carpet cut near the footlights, used for securing the edge of stage cloths and carpets and so preventing the use of nails.

Traps. Small (and usually square) bridges either situated in larger bridges or by themselves. They do not rise above stage level, and were at one time much used in pantomime for the appearance of fairies and demons (star-traps). If any space under the stage is available in the little theatre, it may be used for the storage of scenery and properties. It may be connected with the stage by one or more trap-doors, which can be lifted and taken away (not hinged). These trap-doors will also be useful for stairs, graves and so on, in certain scenes.

For American technical terms refer to end of book.

SOURCES OF LIGHT.

1. LIME-LIGHT. This is an intensely bright white light, produced by heating a small block of lime to incandescence by means of a gas flame of oxygen and some other gas, such as coal gas, hydrogen, or acetylene. It has been superseded by the electric arc-lamp and gas-filled lamp, but it is still very useful in the provinces where neither gas nor electricity are available. In such cases it may be used with good effect from the auditorium in the magic lantern (preferably from the gallery).

2. ARC-LAMPS. They give very intense light, but have many disadvantages:—

(*a*) Current consumption is heavy.
(*b*) They need special resistances, or a 50 volt. supply.
(*c*) They need constant attention, both before and during the performance.
(*d*) They are always liable to flicker.
(*e*) They are liable to make a loud hissing noise, disturbing both audience and actors.
(*f*) They cannot be dimmed with a resistance placed in series.
(*g*) They are not efficient with an alternating current.

In small theatres the arc may be said to be dead, except for special purposes, but in large theatres arcs become almost a necessity, especially where very long throws are concerned, as, for instance, projection from the back of a large auditorium.

Projections by means of "effect" lanterns nearly always require arc lamps, partly because the arc most nearly approximates to a point of light, being therefore good optically, and partly because the arc is still the best means of obtaining very high candle powers within a small compass. Direct current arcs should always be used, especially for "effect" lanterns, where a current of 25 or 30 amperes is usual.

"Pointolite" lamps offer the advantage of the arc without noise or the need of attention, nor do they flicker—but at the moment they are not made in sizes suitable for theatrical use and they would be very expensive to install.

3. Gas-filled Lamps (half-watt type). These lamps are now used in ever-increasing numbers in the home for semi-indirect fittings (alabaster bowls) and indirect fittings (X-ray reflector bowls). They have metallic filaments capable of being heated to a far higher temperature than those of the ordinary vacuum lamps, due to the fact that the glass bulb is filled with a special gas. For this reason the light is white and approximates to daylight. They give more light for the same current consumption than the vacuum lamps, but their initial cost is rather higher. They are made for all the common voltages and in sizes ranging from 60 watts to 3000 watts. The 1000 watt lamp may be considered to give about 1500 candle power. They can be used on the stage in flood-lamps, spots and projectors. The heat generated in the lamp is considerable, and any box constructed to contain it must be of sufficient size and well ventilated. These lamps are moderately strong, and stand handling better than the vacuum lamps mentioned below. They can be obtained in sizes of 60 to 150 watts with the ordinary household bayonet fitting, and also in the 200

watt size *if specially ordered*. The sizes from 300 watts upwards are fitted with screw caps, and need a special *goliath screw* holder. The intermediate size of 200 watts is usually fitted with a screw cap which needs an *Edison screw* holder (similar to the goliath, but smaller). To prevent complication and to allow of the interchange of lamps as far as possible, I recommend that this medium-sized lamp and screw holder be avoided on the stage.

4. Vacuum Lamps. These are the ordinary metallic filament lamps, the globe being exhausted of air. It is not possible to run the filament at so high a temperature as the gas-filled lamp, and consequently the light is more orange in colour. Where the lights are visible to the eye this is an advantage. The lamps are cheaper than the gas-filled, but take more current for the same amount of light. This type of lamp will not bear rough usage, so it is a source of expense in the theatre where it is often used for battens and footlights. For theatre use it is better to buy the *traction* type of lamp, which is specially made to stand the jolts of trams and trains. They cost a little more, and can only be obtained direct from the makers, as there is no demand from retailers, but the money saved in breakages soon exceeds the extra cost. I do not recommend using vacuum lamps larger than the 60 watt size.

5. Special Lamps. There are various special lamps used for spot lights and projectors which are supplied with the apparatus. As a rule it is cheaper to hire such plant, which can be done very reasonably from such firms as Messrs. Digby, Gerrard Street, London, W.1; Messrs. ReandcO, 55, Neal Street, London, W.C.2, and the Strand Electric Company, 28, Floral Street, London, W.C.2. The special gas-filled lamps with "grid" and "gate" filaments, and so on, are very much more expensive than the same wattages in the ordinary lamps, and will generally need careful handling, and must be burnt in one position only, as specified by the makers.

LENSES, MIRRORS AND REFLECTORS.

The optical systems used in the theatre are very simple. *The plano-convex lens* is the most used for the purpose of confining to a definite path the light rays from any of the sources already given. In Fig. 2 will be seen the theoretical effect of a source of light placed at the focus of a plano-convex lens (plain line) and between the focus and the lens (dotted line). The lenses are made in various diameters and of different focal lengths. By a lens of 4 inch focus it is understood that if a source of light is placed four inches away from the flat side a beam of parallel light rays will emerge from the other; and conversely, a beam of parallel rays will be brought to a focus four inches from the lens. It will be seen that to spread out the beam fan-wise it is only necessary to move the lens nearer to the source of light. There is, of course, a limit at which the lens is so near the light that it will crack with the heat. If it is necessary to spread the beam more than this limit allows, a lens of longer focus should be used.

When an arc lamp is used, these conditions are approached in practice, as the light source is small in area, and a very defined beam of nearly parallel rays can be obtained. The actual shape of the circle of light coming from the lamp can be modified by using masks placed in front of the lamp. This is frequently done when it is desired to mask off the top of the beam, so that only the acting-area of the stage is covered, to the full width, without any light striking the back-cloth. The beam has such sharp edges that, except in the rare event of this being actually desired, frosted gelatine or glass is used in front of the lamp to soften the effect and give what is known as a "soft-edge" spot. It is useless, of course, to use frosts (or diffusers) together with masks.

Using other sources of light such as gas-filled lamps, although for this class of work they are specially made

with the filaments concentrated as much as possible, the area of the source is relatively so large that the conditions shown in Fig. 2 are changed very greatly. A fresh

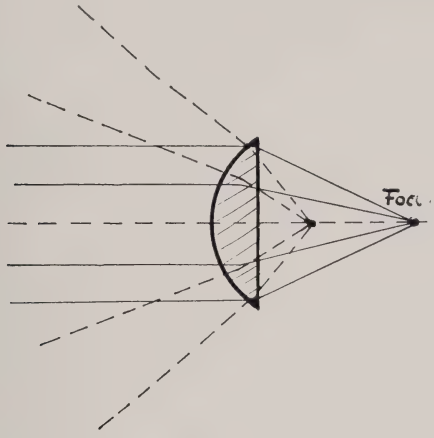


Fig. 2.

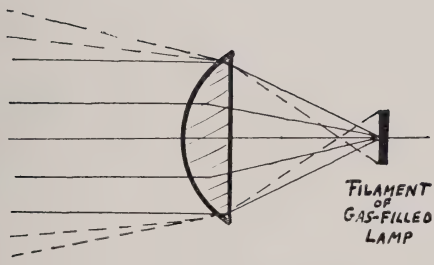


Fig. 3.

diagram (Fig. 3) shows how the main beam appears to be much the same, but surrounded by a secondary beam. In this case a soft-edge spot is automatically produced, but masks in front of the lamps are useless as the rays

are not even approximately parallel. In most cases where simple lenses are used there is a certain amount of light reflected in odd ways off the surfaces of the glass (internally, etc.) which gives rise to a "phantom" ring of light round the main beam and is frequently a source of trouble (see Focus-Lamps). In some positions there is trouble with a magnified image of the filament (see spherical mirrors).

Parabolic Mirrors can be used in exactly the same way as plano-convex lenses, see Fig. 4, but the latitude of

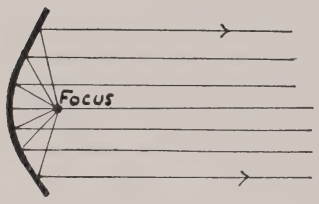


Fig. 4.

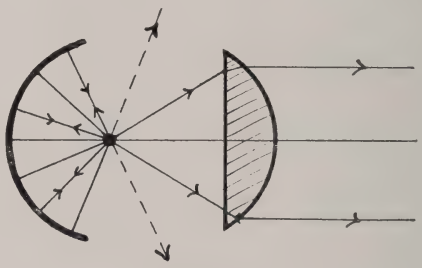


Fig. 5.

adjustment is not so great. Large 3000 watt gas-filled lamps are sometimes used to give large soft-edge beams using parabolic mirrors and plain glass fronts. The mirrors are very expensive (£5–£10), but if of large size and well ventilated they last almost indefinitely. (Those most used are sold under the name of "Mangin" reflectors.) Searchlights are made on this model, but for use with arc lamps.

Spherical Mirrors are used to intensify the light from the source by reflecting back the rays that would otherwise be lost. (See Fig. 5.) They are not of very high efficiency in small sizes. As it is essential that they should be good optically, they are made in silvered glass, which is expensive. The larger and more expensive Mangin mirrors last well, but the smaller ones, which cost about 10s. and have to be used near the source of light, do not stand the intense heat from 500 or 1000 watt gas-

filled lamps. These mirrors do intensify the light somewhat and overcome the difficulty of the filament image (see page 10) by giving extra scope for adjustments, but I do not recommend their purchase. I have found no small mirror of this type which will stand continuous use for more than a few weeks. It is to be hoped that the firms making stainless steel mirrors will perfect their process sufficiently to put a cheap one on the market in the near future.

Reflectors. These are used in floods, battens and floats and do not need to be true optically. Their surfaces are whorled, corrugated and dented, in order to scatter the light as much as possible. The only reflectors I have found really satisfactory are those of stainless steel, now sold by Messrs. ReandcO, of 55, Neal Street, W.C.2, and the General Electric Co., Kingsway, W.C.2, which are cheap, unbreakable and fairly efficient, and the silvered glass "X-ray" reflectors, made by the National X-ray Reflector Co. New York, and sold by the British Thompson-Houston Co., Mazda House, Newman Street, W., and "Sunray" reflectors, made by the Strand Electric Co., 28, Floral Street, W.C.2. Both these are very efficient, but more costly, and breakable. Finally, Messrs. Holophane, Elverton Street, S.W.1, now make prismatic glass reflectors for battens and floats, which are probably the most efficient on the market, but have the grave disadvantages, of high cost, weight, bulk, and breakability.

It may be mentioned that:—

A good White surface reflects	40%	of the	light	falling	on	it.
White enamel	,, 70%	,,	,,	,,	,,	
Polished steel	,, 60%	,,	,,	,,	,,	
Aluminium	,, 67%	,,	,,	,,	,,	
Silver	,, 92%	,,	,,	,,	,,	

A slightly more elaborate optical system used in the theatre is for the projection of an actual image (such as a lantern slide), or of a very highly directed beam for very sharp spots, variable in size by means of an iris

diaphragm. It is essentially only a system of plano-convex lenses (forming a condenser) which concentrates the rays coming from the light source into a cone for the illumination of the slide (or other object). (See Fig. 6.) The image of the slide is focused by means of an adjustable objective lens. This is merely the well-known magic lantern, so, within limits of focusing, the image increases in size the further the lantern is away. As on the stage the lantern is usually in a fixed position,

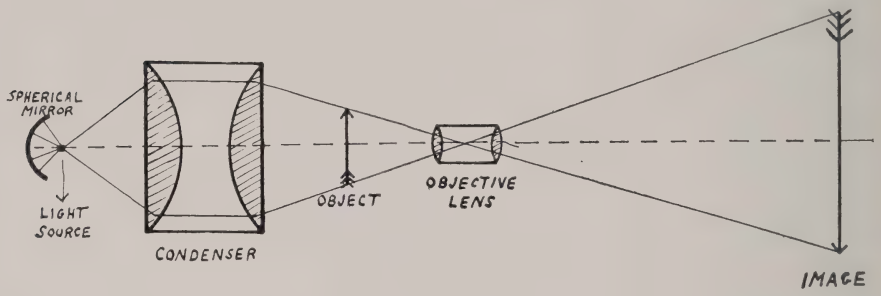


Fig. 6.

the objective lenses are changed instead, wide angle lenses being used for producing large images and narrow angle for smaller ones.

Use of Plane Mirrors. Plane mirrors are often useful to save tilting a lamp at a sharp angle, especially when using gas-filled lamps designed to burn in one specified position, e.g. as in Fig. 7, where it is desired to direct a beam vertically downwards. The cloud machines in Figs. 31 and 32 have a number of these mirrors fixed to them.

THE PRINCIPAL TYPES OF LAMPS USED.

1. Flood Lights.

(*a*) The simplest form is a box having a wide open front which allows the light to scatter evenly over a

wide angle. The front may be fitted with mediums for changing the colour of the light. (See Fig. 8).

(*b*) This type is the same as the one described above, but the light is not allowed to scatter over so wide an angle. This may be done by adding a deep hood.

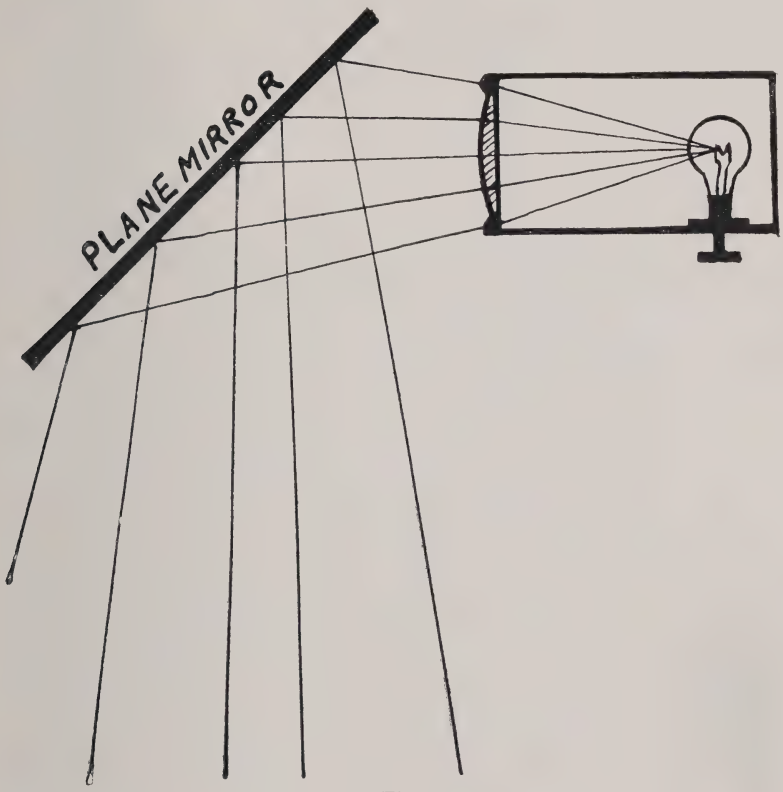


Fig. 7.

Acting-area lamps are frequently fitted so. These lamps hang from the grid, and the hood is of such a size that the light is only allowed to fall vertically on the part of the stage occupied by the actors, and not on the back-cloth or other scenery. The same result can be obtained by the use of lenses. When using such a lamp in any part of the auditorium a lens must always be used to

keep the beam of light *inside the proscenium frame*. If no lens is used, the whole proscenium is illuminated, and possibly the back of the heads of the people in the front rows. This looks very bad and destroys the stage illusion. These lamps are usually called *focus-lamps*.

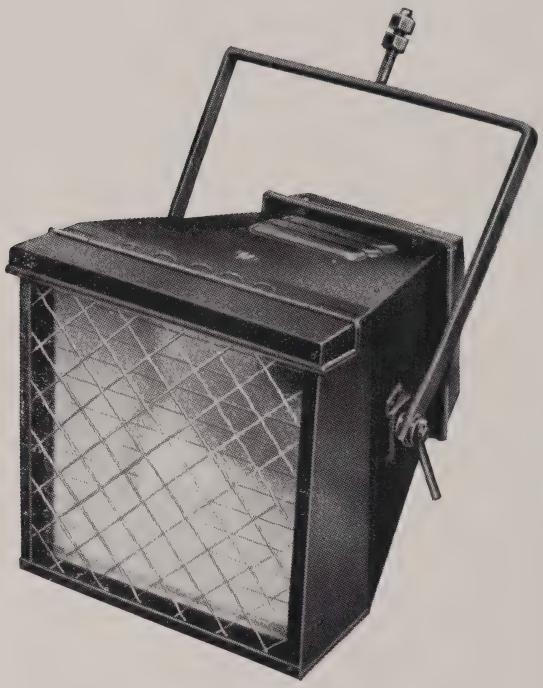


Fig. 8.
G.E.C. 500 Watt Box Type Flood.

2. Focus Lamps. (See Fig 9.) The lens used is a plano-convex, and the lamp is generally smaller in the body than a flood lamp. Arrangements are made to slide the light source and mirror to an fro, and there are grooves in the front to take the lens, colour mediums and frosts, and, if necessary, a second lens to form a condenser (in America called a *Dutchman*) so that the lamps can be converted into a projector or "effect"

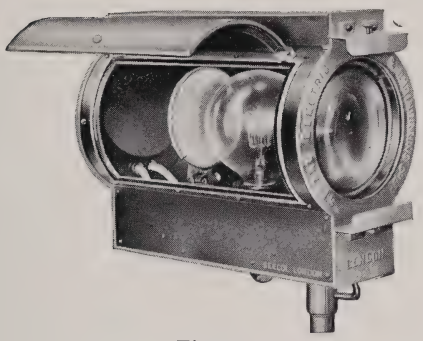


Fig. 9.
Strand Electric Co., 500–1000
Watt Focus-Lamp.

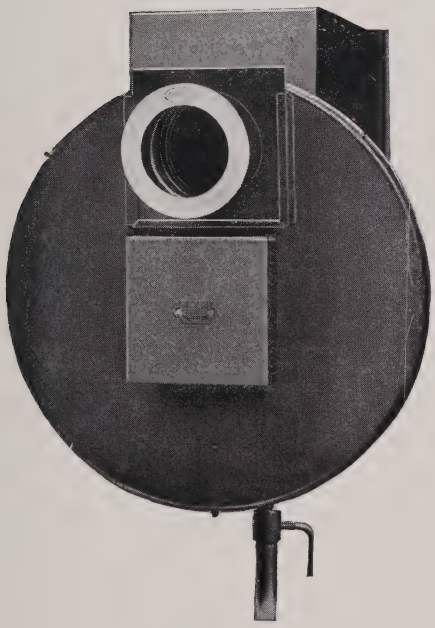


Fig. 10.
Strand Electric Co., "Effect" Projector
with Clockwork Slide.

lantern with the further addition of slide and objective to the dutchman. (See Fig. 10.)

These focus lamps, indeed, are frequently referred to as "projectors," which is very confusing. When the lamp is as near the lens as is safe, the fan of light is so wide as to be nearly a full flood, and in the back position the beam is the same diameter as the lens, and then the lamp has practically become a "spot." At the Festival Theatre, where focus-lamps are used extensively with gas-filled globes, I have to some extent got over the "phantom ring" difficulty (see page 10), by fixing a telescopic tubular hood to the front of the lamps. The hoods fit into the grooves for the gelatine mediums, and are an inch or two larger in diameter than the lens, and are four inches deep when closed, extending to seven inches.

Masks can be fitted into the far ends of the tubes, and when thus used some distance from the lens, they are fairly effective. No doubt with a funnel-shaped hood of much greater length, this would allow of very sharp and efficient masking indeed, but I have not tried the experiment owing to the bulkiness and the unsightly effect from the auditorium.

Frosts are frequently necessary when a hard defined circle of light is not required. (See table of mediums at end of book.)

3. Spots. Spot lights work on the same principle as focus lamps, but are generally smaller, especially in the case of "baby spots," which are designed to occupy odd restricted places and have little or no adjustment of the lens relative to the lamp. In fact the spot is often a non-adjustable focus-lamp, and the answer to the question "When is a spot not a spot?" is "When it becomes a focus-lamp."

Spots are generally used to light a small area—for instance, to intensify the light on the top of a desk where it is necessary for the audience to see some small important article, or to light up one particular actor, or

his face alone. Baby spots are often concealed in fire-places, under tables, and inside stage props of every description with amazingly good results. (See Fig. 11.)

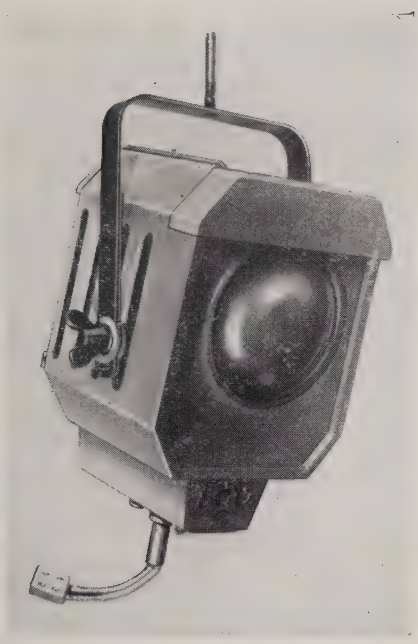


Fig. 11.
G.E.C. 500 Watt Baby Spotlight.

It is next to impossible to make a spot by putting a long hood on a small flood box.

4. PROJECTORS are used for special effects such as clouds, mist, flames, etc. As already explained, they are of the nature of a magic lantern. An ordinary magic lantern can sometimes be used if it is a good one, or an *American effect* can be hired complete with slides worked by clockwork. (See Fig. 10.) Producers should avoid most realistic effects, such as flowing water, waves, and so on, as these are nearly always failures, even on a large scale.

Projectors, owing to their more elaborate optical system, give perfectly controlled bundles of light rays, but in doing this it must be remembered that a great percentage of light is lost—partly by absorption in the lenses themselves and in the case of gas-filled globes, because only a portion of the relatively bulky filament is efficiently used. The result of turning a focus-lamp fitted with a 1000 watt gas-filled globe into a projector is very disappointing indeed; and except for very small theatres, a direct current arc is the only suitable source of light (see Chapter VIII).

When hiring projectors, care should be taken to give the size of image required and distance from projector to image ("throw") so that the suppliers may fit a suitable objective lens.

Chapter II

SOME ELECTRICAL CONSIDERATIONS— DIMMERS

The person responsible for the electrical equipment of the Little theatre usually has the necessary technical knowledge. The contents of this book may help him to apply it in the service of the Drama. Those lacking technical knowledge are recommended to read a text-book such as that cited in the Bibliography. Those who prefer to remain ignorant must rely on the principles of stage lighting given in Chapter VI, combined with the co-operation of an electrical expert. It must be pointed out, however, that it is extremely difficult to explain these principles to the average electrician, who has little experience of stage work and is deeply prejudiced by the routine of domestic lighting.

When work is to be carried out by an outside firm and tenders are submitted, it is not always the lowest which should be accepted. The details should be studied and criticised, and not only the gross expenditure. Moreover, it is generally cheaper in the end to employ a good firm above suspicion and pay a good price. The greatest care should be exercised in supervising the work of contractors, as they frequently scamp their work in places where inspection is unlikely, such as under floors and above ceilings. In inaccessible places like those mentioned, contractors may leave cables without protection to be gnawed by mice and rats, and thus cause endless trouble and possibly an outbreak of fire.

Before passing to the very important question of Dimmers, it is advisable to emphasise one or two points not always mentioned in the text-books.

ELECTRIC CABLES.

It always pays to get first-class material. The method of installing the cable not only depends on local tastes, conditions, and insurance companies, but possibly on the regulations of a licensing authority. Whatever may be the protective system that is used for the cables, it should be continuous, and no gaps be allowed at switches or other fittings. A system such as Henley's has much to commend it. For movable lights *workshop-flex* is the best cable to use, as it is cheap and stands hard wear. The ordinary flex for domestic reading lamps is unsuitable. Another type of cable especially suitable for floor work is *cab-tyre* flex, which is heavily insulated with canvas and rubber, and stands kicking about very well. It is not good for fixing on a wall, because when it is not moved about, the rubber soon perishes.

FUSES.

These should be of such a pattern that the face and hands are protected in the event of a *blow*, while the electrician is inserting a new fuse in the fuse-box. The tubular pattern is good. Spare fuses should be kept in stock to guard against delay during a performance.

SWITCHES.

Main switches should be totally enclosed and chosen for silent action. It always pays to buy first-class switches by a well-known maker. Switches should be of the quick-make as well as quick-break pattern. Always err on the side of under-loading switches. If ordering for a seven-amp. load, get a ten-amp. switch rather than overload a five-amp. one; it is economical in the end and safer.

PLUGS.

Never use the ordinary house variety, they are too small for stage use, and wear badly. A plug of fifteen-amp. size is best, and not much more expensive. Still more desirable is a large plug with a cord-grip. (Stages are peopled by fools, who pull out plugs by hauling on the cable.)

RESISTANCES—*Dimmers.*

No substance is known that will transmit electricity perfectly. Speaking electrically, matter may be divided into two classes; those substances which conduct electricity well, and those which conduct it badly. The latter class are usually called insulators. It may also be said that there are no perfect insulators.

When an electric current passes through a resistance, the resistance itself tends to rise in temperature. The heating effect is proportional to:—

$I^2 \times R$, where I = current-intensity (amperes)
and R = resistance in ohms.

It will therefore be seen that a small increase in current may cause a serious heating effect in a conductor, and hence great care should be taken to see that the cables in any installation are big enough to offer only a small resistance to the maximum current which will flow in them.

It is frequently necessary on the stage to alter the amount of light upon it, and when this has to be done suddenly it is a simple matter to do it by moving the necessary switch or switches. When the stage is to be suddenly darkened (technically known as a *black-out*), it is usual to switch off a main switch. Frequently, however, the change must be slow and almost imperceptible to the audience, as in sunsets, moonrises, etc. This can only be done conveniently by gradually placing resistance in the lamp circuits. This is effected in several ways:—

1. By a slider-type or stud-type metallic resistance.
2. By a liquid resistance.
3. By an embedded plate-type resistance. Owing to the fact that the plates are embedded, quick and easy repairs are not possible, but this type occupies less room than any other. They are little used in England, but are common in America.

1. The Slider-Type and Stud-Type Resistance.

These resistances are made of coils of wire, having relatively high resistance, arranged in such a way that all or part may be introduced into the lamp circuit as desired.

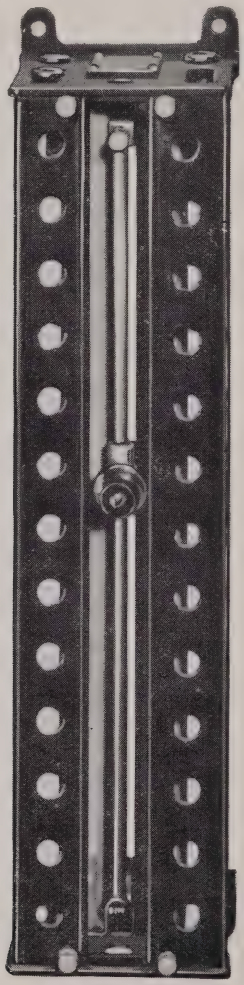


Fig. 12.
G.E.C. 1000 watt.
Slider Type Dimmer.

For circuits up to 2000 watts this is frequently done by winding the resistance wire upon a cylinder of non-conducting material. A sliding contact can be moved over this coil, gradually increasing or decreasing the amount of wire in the circuit. (See Fig. 12.)

For circuits of higher power than 2000 watts, the resistance wire is supported by insulators on a metal frame. Each coil is connected to a metal stud. By moving a metallic arm over the studs the resistance is varied in a similar manner. (See Fig 13.)

These resistances can be bolted to a wall or the switch board, and must be protected by a stout guard of wire or sheet metal. When used for long periods the resistances become very hot, and they should therefore be well ventilated.

The requirements of a good resistance are:—

(i) That it should offer no obstruction to the passage of the current when not in use.

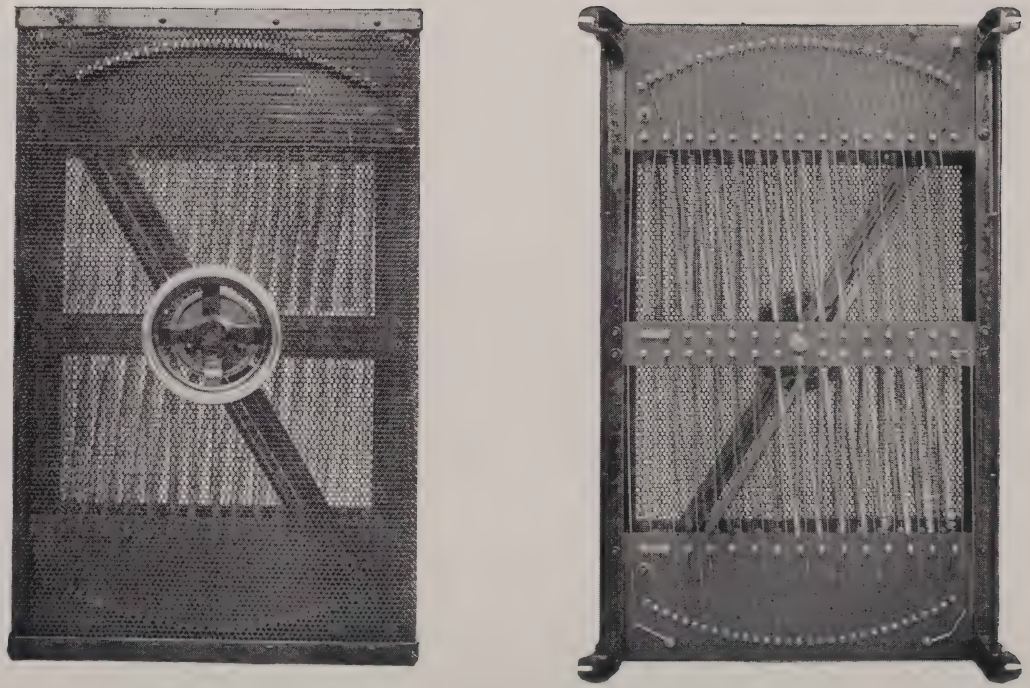
(ii) That the lights may be dimmed without flicker or jerks from "full-on" to "off."

(iii) That the design should be such as to allow its use for long periods without overheating.

With the sliding contact pattern these are easy matters.

With stud-contact type care must be taken that the resistance between the studs is not too great, and that the contact arm makes connection with a new stud before leaving the previous one.

Metallic resistances must be designed for a definite load, and are not suitable for any other. The latitude allowed is only about 20 per cent. This means that with a dimmer designed for a load of 1000 watts, it is possible with careful management to work a load of 800 or 1200 watts. In the latter case overheating must be allowed for, and long periods of use may be impossible without risk of burning out the coils. Badly made resistances often give trouble with sparking at the contacts, and it is not advisable for the Little Theatre



(*Front view.*) Fig. 13. (*Rear view.*)

G.E.C. 60 Contact Radial Lever Metallic Type Dimmer with operating Handwheel.

to try to manufacture its own wound resistances. The cost of the sliding contact type is from £2 to £5, and of the stud-contact type from £6 to £10 at present prices.

In big installations the licensing authorities generally insist upon dimmers being placed in a fire-proof chamber away from the switch-board. In Fig. 14 on the right is illustrated the master-control apparatus supplied by Schwabe (whose agents in this country are the General Electric Co.). Three banks of control winches are shown, each consisting of a row of small handles which move over the graduated dials and control tracker wires going to the dimmer room. Any or all of these handles can be locked and worked together by the master-control wheels on the left of the apparatus. For a slow, continuous motion the small gear wheels shown on the left can be put into operation. On the left of the illustration is shown one dimmer frame in both side and end elevation. This particular dimmer is probably the best that has ever been made for theatrical purposes. The resistance wires are shown wound on bobbins, the tappings from each section being brought out through asbestos-covered leads to a series of studs, shown on the left. The contact arm moving over these studs is kept in its lowest position by a weighted rod and is drawn upwards over the studs by the tracker wire which is attached to the shackle above.

2. The Liquid Resistance.

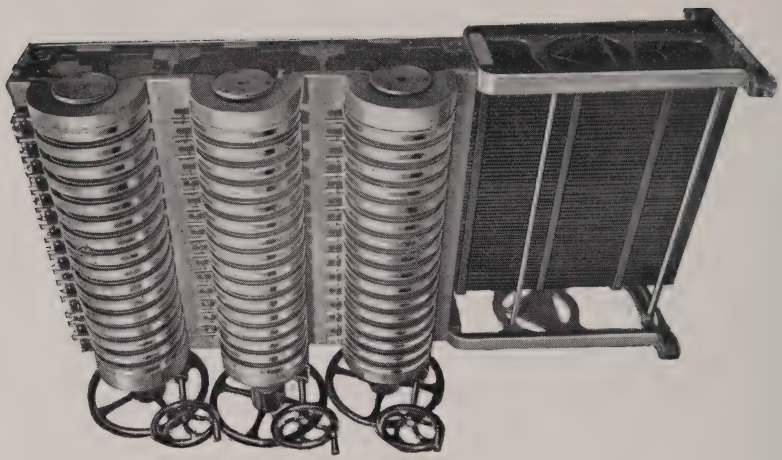
For heavy currents these resistances are more suitable than the metallic kind, and have the following advantages:—

(i) They are compact, safe and cheap.

(ii) There are no metallic contacts to be destroyed.

(iii) The variation of resistance can be as gradual as required.

Against this must be set the fact that it is impossible entirely to cut out the resistance unless a short-circuiting device is employed.



G.E.C. 3-Tier Type Dimmer Control Regulator.

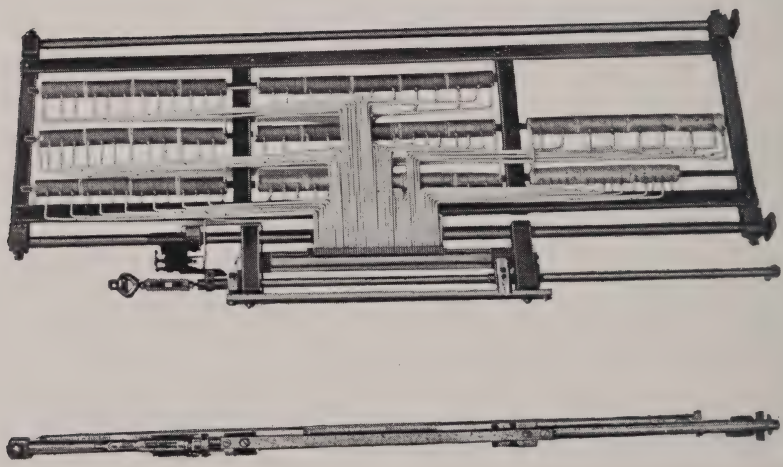


Fig. 14.

(*Side and end views.*)

G.E.C. 100 Contact Metallic Type Dimmer.

In Lyons' resistance the positive and negative plates (or electrodes) each consist of cones fitting one into the other, so as to ensure as good contact as possible. Even with this arrangement there is a drop of nearly a volt with the normal current, and this is largely increased unless the apparatus is kept in good order.

The electrodes often consist of:—

(i) two plates, or

(ii) a plate and the containing vessel, or

(iii) a rod and the containing vessel.

The metals most generally used are wrought or cast iron (for alkaline solutions) and lead (for acid solutions), carbon also being occasionally used.

The resistance can be varied, either by moving the plates up to, or away from, one another, or by withdrawing one or both from the solution. When the latter method is employed the electrodes are often made triangular in shape, so as to increase the possible variation.

For voltages above 1000, water may be used; below this, however, it is necessary to increase the conductivity by adding sulphuric acid or soda. With this solution there is a drop of about 4 volts per inch between electrodes, assuming a current density of one ampere per square inch. With gas-filled or vacuum lamps it is necessary to absorb about 75 per cent. (or rather more) of the voltage in order to reduce the light to zero.

A Lyons' liquid resistance mounted in a wooden frame to stand on the floor, and fitted with cone electrode and a winch for raising one cone out of the solution, costs about £8. It is capable of taking a current of 20 amperes safely.

A similar "home-made" resistance will cost from 5s. to £2, according to the ingenuity of the maker. In designing such a resistance, first decide on the materials to be employed. For small ones on circuits up to 5

amperes a large pickle jar will probably suffice. For circuits up to 10 amperes an ordinary drain pipe is convenient, the large end being closed by a tile cemented in. For 30 ampere circuits I have successfully used large earthenware pipes, 48 inches in height and 12 inches in diameter. These can be obtained from such firms as Doulton's for about 30s. each.

The cone electrodes can be cast in lead; or if this is too troublesome, flat iron plates can be used. In the latter case the surface should be machined smooth. The electrode question depends on the material at hand, and the facilities for working it. The second question to settle is the size of the plates. The current density should never exceed one ampere per square inch, and half an ampere will be found a convenient value. Thus for a dimmer taking a maximum current of 20 amperes the plates should be at least 20 square inches at the area of contact. If they have a greater area, so much the better.

The top plate should be heavy, as when they rest together gas is formed, tending to force them apart, and if this happens, the lights will flicker.

A reference to Fig. 15 will show how the apparatus is constructed; the lower electrode rests on the bottom of the vessel, from this a rod rises above the surface of the liquid and is connected to the electric supply.[1] This rod must be insulated by means of rubber tubing slipped over it. In small dimmers the top plate may be raised and lowered by means of the insulated cable attached to it and running over a pulley, but care should be taken to prevent the weight being taken on the electric connection. For large dimmers the cable required will be too large and stiff to run over a pulley, and a cord should be used instead, the cable being left free, but the electric connection again being protected by fixing the cable at a point a few inches from it. In Fig. 15 the dimmer is

[1] In direct-current installations the bottom plate should be connected to the positive cable.

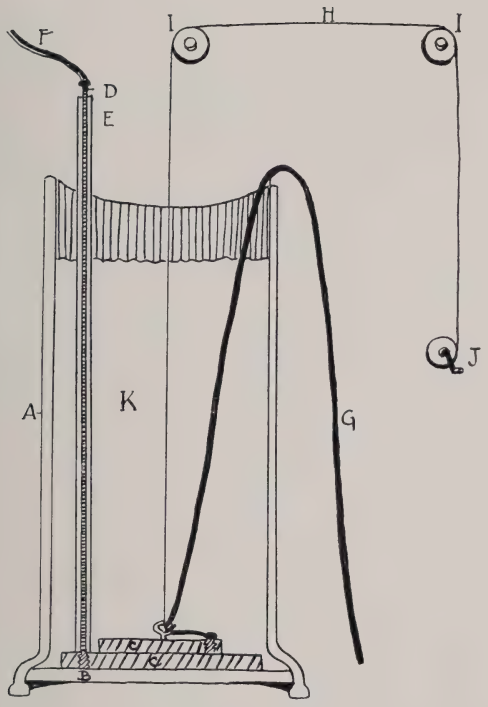


Fig. 15.

Home-made Dimmer.

A. Drain pipe. B. Tile cemented in.
C. Iron plates. D. Iron rod. E. Rubber tubing.
F. Positive and G Negative cables. H. Cord.
I. Pulleys. J. Winch. K. Electrolyte.

shown arranged for distant control. The vessel itself may be below the stage or in any other convenient place,

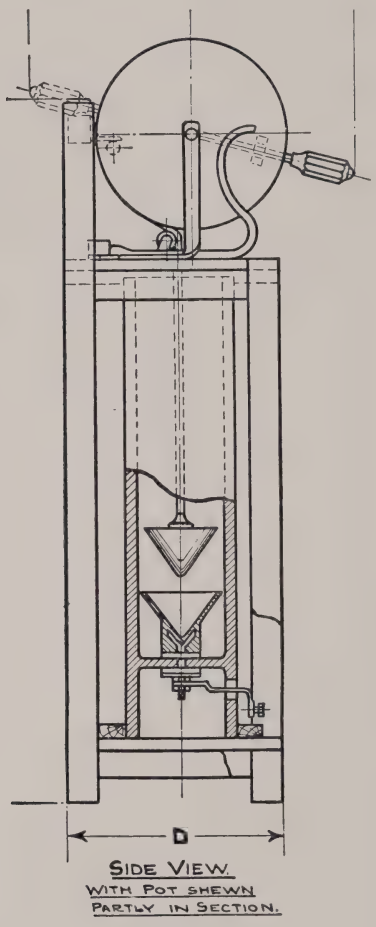


Fig. 16.

and the winch on or near the switchboard. Fig. 16 shows a Lyons' resistance complete with frame and winch.

Fig. 17 shows a complete set with distant control by *tracker* wires, and arrangements for interlocking the winches for control by master handle.

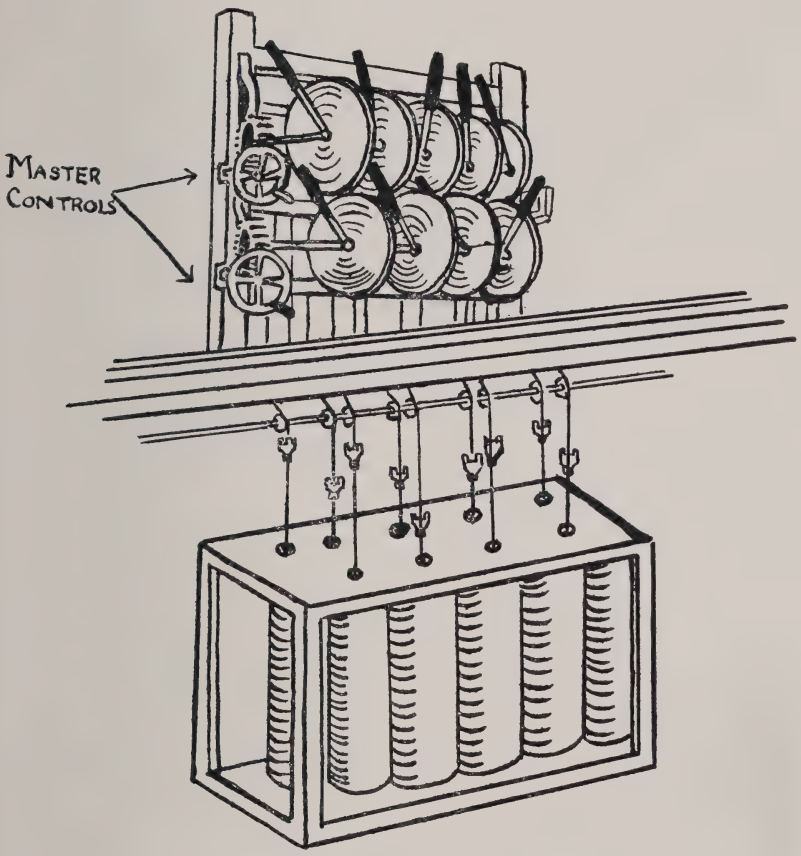


Fig. 17.

For the small size of dimmer it will be sufficient to allow the plates to be separated about 12 inches, the larger sizes for currents of 10 amperes and over will require a separation of 30 inches for 100 volt. circuits to 40 inches for 200 volt. circuits to give the best results.

The third point to be determined is the quantity of

liquid (the electrolyte) to be used. The minimum quantity to absorb the heat generated and so prevent boiling is one cubic inch per watt for dimmers up to 10 amperes capacity, and half a cubic inch per watt for the larger sizes.

As the minimum diameter of the vessel is given by the size of plates, and the minimum height by the distances they are to be separated, it only remains to see if this allows room for the electrolyte. If too small, the diameter, or height, or both, may be increased.

The last matter to be settled is the strength of the electrolyte, and a number of rules for this could be given, but it saves time and trouble to adjust this by the method of trial and error.

Having constructed the dimmer as detailed above, fill with water to within about 9 inches of the top. With the electrodes in contact with each other, switch on the lamps it is desired to dim down. It will be found that a very small separation of the plates will be sufficient to put the lamps out.

Now add a small quantity of sulphuric acid, or soda, as the case may be, and stir well.[1] It will be found that a greater separation of the plates is now necessary for the same result. For the best working the strength of electrolyte is such that the electrodes are separated to their full extent to bring the light from full-on to off.

A few hours spent in playing about with a dimmer of this kind, using different loads, is more useful to the beginner than any amount of description.

Characteristics of Liquid Dimmers.

The latitude of liquid dimmers is far greater than that of the metallic variety, one reason for this being that

[1] Sulphuric acid is dangerous. On no account should water be added to it. The correct method is to pour the acid slowly and carefully into the water ; the heat generated in the process is considerable. The soda (ordinary washing soda) should be added in the form of a saturated solution, which should be kept in stock. Many other chemicals can be used as electrolytes, but some give off unpleasant gases when the dimmer is in operation.

when used for heavy loads they have the advantage of the smooth action of a sliding contact metallic resistance.

As an instance of this, suppose a liquid dimmer adjusted to dim a load of 1000 watts, the plates being separated 36 inches in the process.

If a load of 2500 watts is now dimmed down it will be found that the plates will only have to be separated about 12 inches instead of 36, and care will be necessary to prevent the lights going down in jerks, especially at the start. In all probability it will be impossible with the greater load to get quite full light even when the electrodes are touching. If the solution is strengthened to suit the greater load it will be found that the lights will only be half out on the small load. When varying loads in this way, the dimmer must be designed for the larger, but the electrolyte adjusted for the smaller.

A dimmer when kept in action for a long time with the plates in contact is liable to cause a flicker in the lamps due to gas, generated between the plates, forcing them apart. The use of a heavy top-plate minimises this, but the better method is to have a short-circuiting device which operates when the electrodes are together.

If a dimmer is overloaded for any length of time the liquid will boil and be expelled violently from the pot, not only causing a mess, but putting the lights out of action. Violent sparking may also take place between the electrodes, and if someone rushes to the rescue with a bucket of water and pours it into the pot he will receive a violent shock.

It is easy to design the dimmer to have sufficient capacity to prevent this overheating, and then it will be found to be very safe and reliable.

Overheating in a metallic resistance is much more serious, and may be the cause of an electric fire. In dealing with an electric fire, water is useless, and buckets of dry sand should be kept ready instead. Obviously the current should be switched off; but if this is impossible, the sand may stop arcing and the spread of the fire.

The ideal arrangement is to have a dimmer in each circuit on the switchboard. These can be used independently, or the winches can be coupled up mechanically and all worked together for dimming the whole stage. This is the arrangement in all large theatres. The use of a single dimmer is discussed in Chapter III.

Note on Alternating Current Dimmers.

The metallic or liquid dimmers already described are somewhat wasteful, whether used in continuous or alternating circuits.

When the light given by a set of lamps has been reduced to, say, a fiftieth of its original value, the power in the circuit may be reduced to only half. This power is being used principally in heating the resistances.

On alternating circuits it is possible to use *choking-coils* which will cut down the power and light with practically no waste.

These coils consist of a solenoid, into the interior of which a core of soft iron wires is introduced. The iron core, as it enters, reduces the current in the solenoid by self-induction effects.

The construction is very simple, but at present these coils are not on the market in a form suitable for the theatre. For this reason I only mention their use in this note.

Chapter III

WIRING SYSTEMS—SWITCHBOARDS

The stage wiring of a Little Theatre had better be of either the semi-permanent or the temporary type. Permanent installations are not only more costly, but are in the end inconvenient. They do not lend themselves readily to alterations and additions.

I regard the semi-permanent installation as one in which the switch-board, fuses and principal parts of the circuits are fixed and only the lights themselves are movable.

In the temporary installation, the entire plant is movable, and is only connected to the electric supply while actually in use.

The Semi-permanent Installation.

This may be a necessity where the stage is being frequently used, and is licensed. The licensing authority will probably not allow a temporary switchboard for more than a few performances. The main difficulty is the provision of dimming apparatus. Where the switchboard can be placed in such a way that the back connections are accessible to the electrician, dimmers may be connected to those circuits in which they are needed. Thus a few dimmers may be sufficient for the lighting of many plays, as they can be used in a variety of ways.

If the switches must be fixed to a wall or inside the proscenium, the method of fixing the cables in conduits,

or otherwise, will make changes difficult. Either each circuit will need its own dimmer permanently installed or some arrangement will be necessary for switching a single dimmer into any circuit or group of circuits, without altering the wiring.

The various conditions under which performances are given are so utterly different, that it is impossible to go into all of them, but the following details of a particular case should give every electrician sufficient information to enable him to modify the plan to suit his own requirements.

The conditions were as follows:—

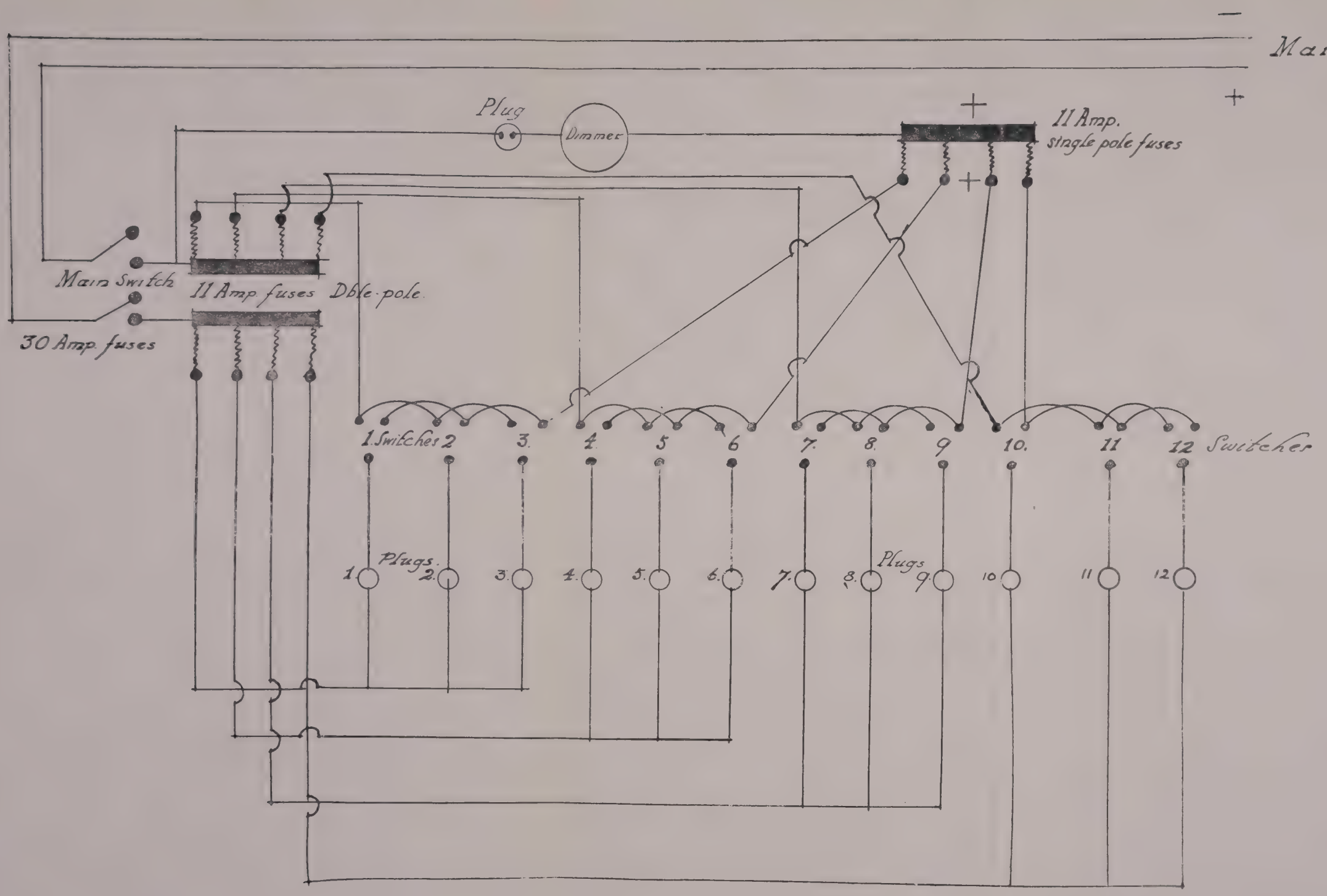
1. The London County Council would only licence the premises on condition that screwed conduit was used.
2. There was no room for a switchboard of the approved pattern giving access to back connections.
3. Funds would not allow of dimmers being used in every circuit.

It was decided to provide twelve circuits serving plugs fixed to the walls of the stage—6 plugs stage right, 3 at back, and 3 stage left.

To save expense these circuits were grouped through four fuses, although it would obviously have been better to have had twelve fuses, one for each circuit. For the same reason only one dimmer was constructed capable of dealing with the whole load. By a system of *two-way-and-off* switches this dimmer could be used in a single circuit or on any number of circuits up to the total.

These switches have three positions. When the knob is in the *up* position the current passes direct to the lamp; when in the *down* position the current passes first through the dimmer and then to the lamp; when in the centre position the current is *off*.

STAGE WIRING & SWITCH BOARD



10 Amp "2 way & off" Switches

DOWN position = Supply through Dimmer

CENTRAL " = Off

UP " = Supply from Mains

Fig. 18.

A reference to Fig. 18 will make the arrangement clear.

As the circuits are grouped in threes to each fuse, the switches have been looped across to save wire. If there were twelve fuses each switch would be connected to its own fuse and the looping would be omitted.

It will be noticed that no account whatever was taken of the lights themselves. Each lamp was provided with a length of workshop flex, sufficient to allow its use in any part of the stage. Single lamps or groups of lamps could be connected as desired to the plugs, this arrangement being varied for each play. The switches must be considered as each controlling their own plugs and not any particular lights. The plug shown near the dimmer is short-circuited when the dimmer is in use. When removed, the plug isolates the dimmer and prevents possible accidents.

As the total load was 4400 watts (20 amperes at 220 volts) the choice of dimmer was between the stud-contact and liquid types. The stud-contact resistance not giving sufficient latitude, a liquid dimmer was used.

The limitations of a liquid dimmer are such that in any one play it can only be used with perfect success under one of the following conditions:—

1. Where only the whole load is to be dimmed.
2. Where only a small fraction of the load is to be dimmed.
3. Where two different but equal loads are to be dimmed.

The reason is that the strength of the electrolyte must be altered to suit each case, which will usually take too long to do between scenes or acts.

As shown on page 25 it is possible to secure fairly good results when working with loads differing as much as 1000 and 2000 watts.

The great drawback of having only one dimmer is that

while one set of lamps is being dimmed another set cannot be brightened. There are three ways out of the difficulty. The first is to have the predominating colour only on the dimmer. Suppose it is desired to change from pink to dark blue. The blue lamps are switched on and left so throughout. The pink lamps are switched on also, but through the dimmer, so that at the beginning they drown the blue light, which only shows up strongly as the pink fades out. The second method is to dim out the pink, leaving the stage dark, and then, after changing over the necessary switches, reverse the dimmer and bring up the blue. The third way is a combination of the first two. Take, for example, a sunset scene in which the sunset glow vanishes and gives place to moonlight, ending with dawn the following morning. In this case we start with a foundation of steel-blue light from the front lamps, and a moon-light flood on the back-cloth from the left to kill the shadows made by these front lamps. These lights remain throughout the scene. The sunset colour comes from red lamps behind a ground row back right, combined with a pink flood lamp from the right high up. The sunset drowns any moonlight from the left. As the sunset is dimmed out, the stage becomes blue with faint moonlight from the back. The lamps used for the sunset are switched off and the centre lamps (or battens) are switched on to the dimmer instead. The dimmer is reversed and increases the light to bright moonlight. Later on the moonlight can be dimmed out again and dawn suggested by some faint white on the back cloth and a shaft of light on some important object on the stage from an amber spot. I mention this to show what a great variety of effects can be obtained from only one dimmer, but at the same time I wish to impress my readers with the fact that very careful manipulation at the switch-board is necessary as well as many hours' work on a complicated lighting plot.

Mr. H. Rottenburg, of the London Instrument Co., Cambridge, has devised a very excellent plug-connection,

illustrated in Fig. 19, for plugging dimmers into the circuit without any break and consequent flicker. In an installation such as that described above, this plug would be ideal. Instead of having the *two-way-and-off* switches it would only be necessary to have the ordinary *one-way* switch and the plug in each circuit.

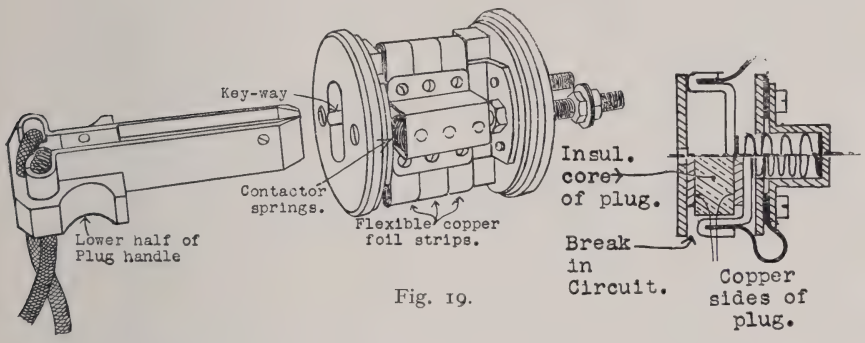


Fig. 19.

Any arrangement of lamps can be used with such a wiring system, but it must be remembered that arc-lamps cannot be dimmed by a resistance. Arcs are dimmed by a shutter, working like the diaphragm in a camera lens.

The Temporary Installation.

Fig. 20 illustrates both front and back of a movable switchboard with six circuits. Power is supplied by temporary cables run from the bus-bars of the main, or sub-main, distribution board of the building.

At the top of the board are the main fuses, main switch and ammeter. The ammeter is a desirable instrument on any board. It is almost an essential on a temporary one—where it is necessary to keep a careful watch on the total current as each new circuit is completed. Nothing is easier than dangerous overloading, as at the last moment forgotten apparatus is hastily connected up.

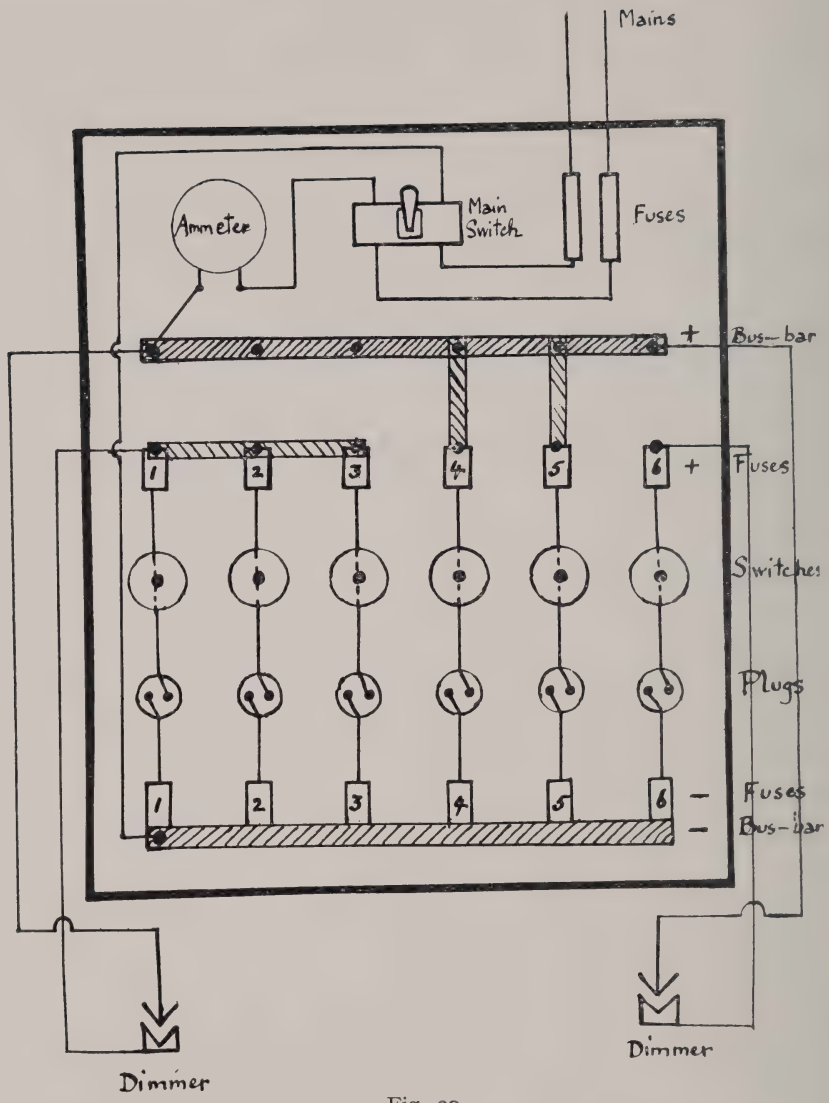


Fig. 20.

The shaded portion (bus-bars, copper strips) and all wiring are at the back of the board. Unshaded portions (fuses, switches, ammeter, plugs) are on the front of the board.

The board has its own bus-bars, one at the top and one at the bottom of the board at the back. The fuses are arranged in the same manner to facilitate connections. The negative fuses have one terminal permanently connected to the negative bus-bar. The positive fuses are connected to the positive bus-bar by copper strips which can be swung round so as to connect two or more fuses together, as seen in the case of Nos. 1, 2 and 3. This arrangement allows a dimmer to be connected up to a single circuit or group of circuits. In the figure Nos. 1, 2 and 3 circuits are grouped on one dimmer, and No. 6 on another.

The plug invented by Mr. Rottenburg illustrated in Fig. 19 will work far better than the copper strips, although the initial cost would be slightly greater.

In the centre of the board are the switches and plugs.

It will be noticed that each circuit is arranged so that fuses, switches and plugs are all in one vertical line. This scheme should always be adhered to, or great confusion will result. Boards are sometimes seen with all the switches in one place and the plugs in another; each being on a different plan. It must be made easy for the operator to pick out any part of a circuit without reference to a diagram or counting up plugs to find corresponding fuses. When enlarging such a board as that illustrated, greater breadth is better than depth. The ammeter should be at eye-level so that room is left below the negative bus-bar for winches to be worked on the bottom of the board. The dimmers can stand on the floor below.

A board such as this should be made of a non-conducting fire-resisting material. A hard wood such as teak is also possible, though some licensing authorities may not allow this. Long flex will be needed on the lamps, as it has to reach to the board in every case.

The back of the board should be made difficult of access for all but the electrician, and the connections must be protected by stout wire guards over the whole of the back.

Extra Circuit. When possible have a plug on the stage not controlled by the main switch on the board, also provide a lamp to illuminate the switchboard from a similar circuit. An "Osglim" lamp is very suitable, as it will not throw a light on the stage during a black-out.

Position of Switchboard. The electrician should be able to see the stage; it is safe to put the board on the proscenium on the O.P. side.

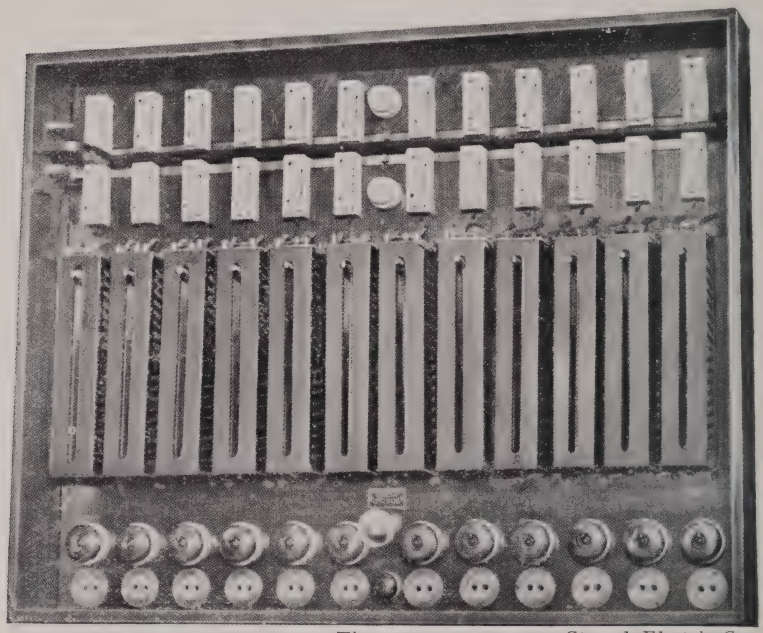


Fig. 21. *Strand Electric Co.*

There is a tendency nowadays to put the board under the front of the stage with a periscope for the electrician.

An illustration is given (Fig. 21) of a portable switchboard having 12 circuits with a sliding-contact dimmer in each. Such switchboards can be hired by the week from The Strand Electric Co., 28, Floral Street, London, W.C.2.

Examples of Full-size Switch Boards.

A standard modern switch-board, designed and manufactured by the Strand Electric Co., is shown in Fig 22. The board is of the *dead front* pattern, i.e., no metal parts carrying current are exposed on the front, thus ensuring the operator against shock, a very necessary precaution in present-day installations, when the *load* is *balanced* on three or more phases of a supply with a potential up to 400 or 500 volts pressure.

The whole of the busbars and connections are at the back of the board, the handles only protruding through to the front.

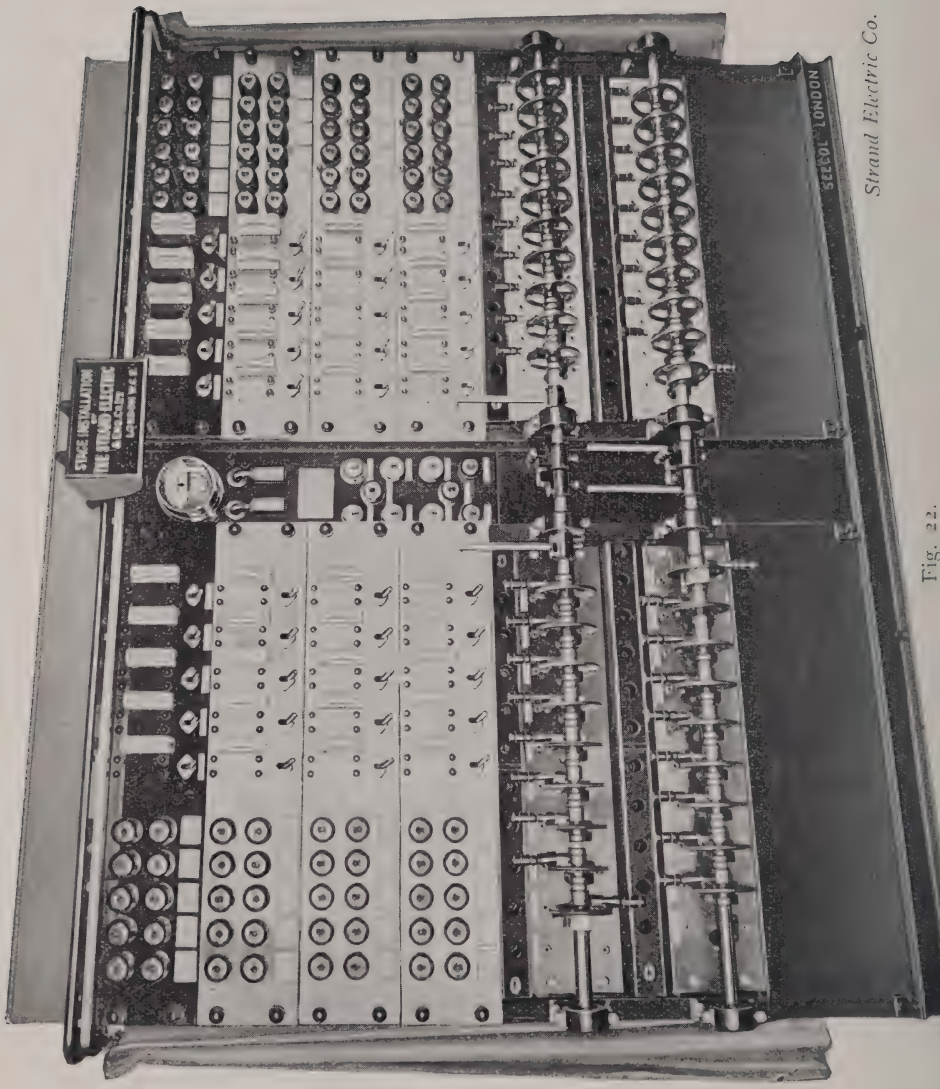
The board illustrated is arranged for a four-colour scheme with master colour switches for each batten, footlights, etc. Sub-switches are also provided, dividing these into two sections on each colour. The stage *dips* are controlled by a master switch on each colour, and an individual switch on each stage socket.

Main black-outs are controlled by magnetic contactor switches which are placed under the stage and operated by the small switches on the centre panel on the board. This method ensures that a black-out is obtained without the noise of a heavy switch.

Below the switch are the wheel regulators for operating the liquid dimmers. They are arranged on four colour shafts and each wheel is capable of being operated individually or of being locked to the shafting, so that a master handle can operate all the wheels on each colour together. In addition, each colour bank is capable of being interlocked to the other colour in the same line, so that the two banks can be operated together.

The board is constructed in accordance with the Home Office rules and regulations.

Boards of this design have been manufactured



Strand Electric Co.

Fig. 22.

recently and installed by the Strand Electric and Engineering Co., Ltd., 24, Floral Street, W.C.2, at:—

Theatre Royal, Glasgow.
King's Theatre, Glasgow.
Mile End Pavilion, London.
Lyceum Theatre, Edinburgh.
Alhambra Theatre, Glasgow.
Birmingham Empire, etc.

Such a board ready for installation costs from about £250 to £300.

A special board installed at the Festival Theatre, Cambridge, by Messrs. ReandcO, is worth consideration as being in direct contrast with the last. This is illustrated in Fig. 23, where the switch panel and dimmer panels are separate, and there is no *mechanical* interlocking. It will be seen that there are thirty-three single-pole knife switches and fuses in three rows, and also a single-pole black-out switch. The negative fuses are grouped at the bottom of the board. To the right of the picture is a bank of sliding contact dimmers controlling the front-of-the-house stage lights and decorative illumination. On the left is a panel of cyclorama lighting controls, and next to it the resistances for the batten, spots and stage dips. There are several independent circuits on the board.

Before leaving this subject it may be well to say a word about the advantages and disadvantages of interlocking.

There is the obvious advantage that interlocking allows one operator to work a number of dimmers and, using both hands, to raise and lower sets of lamps at the same time, thus saving the wages of assistants. It is to facilitate changing the lights from one colour to another that the colours are often segregated on different sections of the board. For instance, if a stage is lit entirely with blue light which is subsequently to be changed to red, it is only necessary to work the master handle on the blue bank in one direction and at the same time to

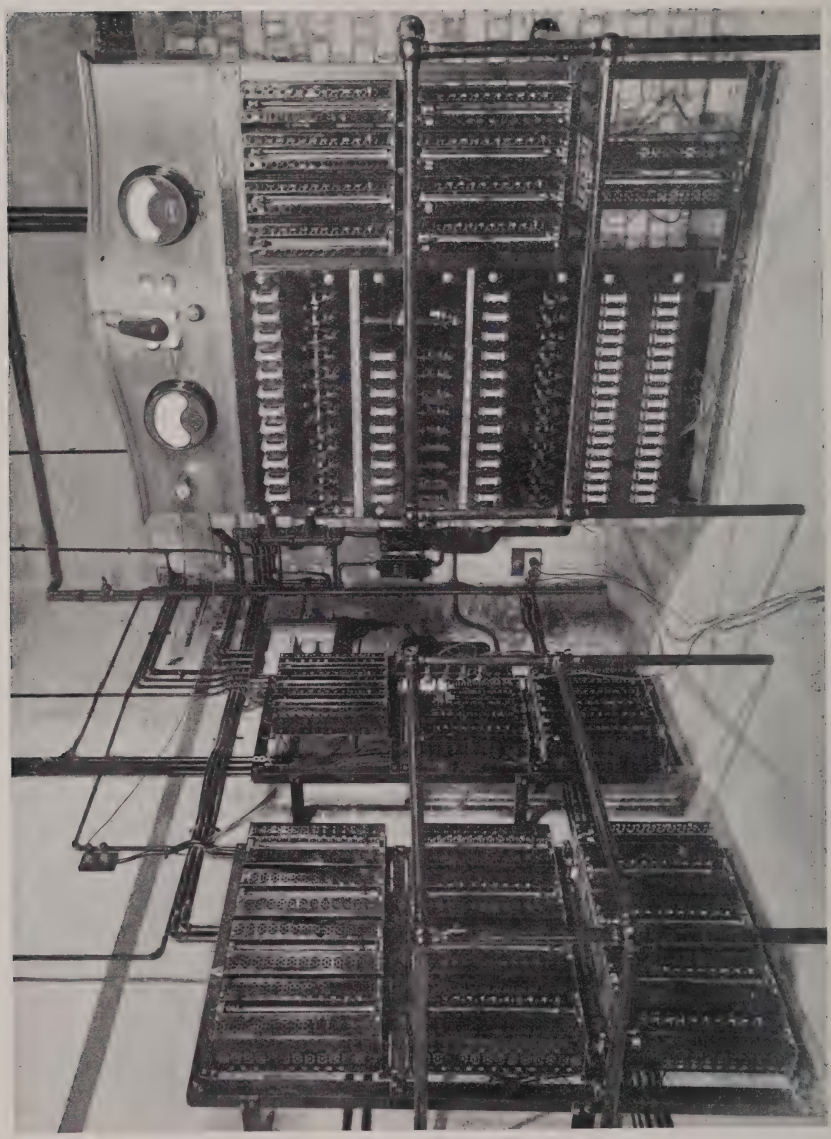


Fig. 23. The Festival Theatre Switchboard. *Scott & Wilkinson, Cambridge.*

move the master handle on the red bank in the opposite direction, whereas if the red and blue circuits were dotted about the board indiscriminately, it would obviously be impossible to do this.

At a slightly greater expense in the initial cost of the board, however, it is possible by doubling the number of ratchets and pawls on the interlocking gear, to revolve the individual dimmer winches in opposite directions while turning the master handle in one direction only. In this case, of course, there is no necessity to arrange the board in separate sections for each colour.

In music halls and theatres which use battens and floats as their principal lighting, the mechanical interlocking system is excellent, but in Art theatres it is not so good; in fact, where colour-mixing is extensively practised, it is of little value. (See Chapter VI.) Another example will make this clear.

Suppose a cyclorama is flooded with violet light by using a bank of dark blue lamps at full power and a bank of red lamps at a quarter power, and that we wish to dim them slowly, keeping the correct mixture. If the dimmers are interlocked mechanically, the red lamps will be out after a quarter turn of the master handle, leaving the blues at three-quarters with a consequent change of light from violet to blue. It is true that dimmers can be fitted with differential gearing, so that the master control will move any dimmer at any set speed, but the expense of this is prohibitive.

Using a board such as that in Fig. 23, it is found that interlocking is very rarely essential, as it is not often that a large number of dimmers need be moved rapidly at exactly the same time. A reference to the lighting of "The Pleasure Garden" in Chapter IX, will give some idea of a fairly elaborate plot where there is obviously no need for any interlocking. When, however, the necessity does arise at the Festival Theatre, a separate master dimmer constructed to take a load of from 4000 to 36,000 watts is used. This dimmer is of the stud type,

and is connected between the supply and the positive bus-bar of the switch-board. This system is one of *electrical* interlocking, as it does not interfere with the setting of the individual dimmers and allows the whole stage to be dimmed slowly or rapidly by one man without change of colour values. This dimmer is fixed above the main switch-board and does not appear in the illustration.

Chapter IV

LIGHTING EQUIPMENT

Battens and Floats.

Old-fashioned battens and floats consist of a metal trough containing a row of vacuum lamps in one or more circuits. The lamps are coloured as desired by dipping in special varnishes. The method is first to see that the lamp is quite clean by washing in soap and water, or using a new lamp without any greasy finger marks on it. The lamp, while burning, is dipped into a pot of varnish and allowed to dry. Two or three dippings may be necessary. The varnish is rather expensive, but goes a long way if a pot is used only just large enough to take the lamp. Up to quite recently the lamp varnish would not stand the heat of gas-filled lamps, but there is now an excellent varnish sold by Bakelite Ltd., Warwick Road, Greet, Birmingham, under the name of "Damarda Lacquer," which will stand the heat from these fairly well.

It is now possible to obtain vacuum lamps made of coloured glass (ReandcO, 55, Neal Street, W.C.2), in sizes large enough for battens and floats. The use of these coloured lamps or Damarda lacquer has given a new lease of life to the old-fashioned trough type of apparatus, and it may be well in theatres already equipped in this way to retain it, or in cases where first cost has to be kept to a minimum. It should be mentioned that when using lacquers or coloured glass lamps the more advanced methods of colour mixing given in Chapter VI are not possible. In all other cases the newer compartment type of battens and floats with

The two mistakes commonly made with floats are first that they are far too bright, and second that the light is allowed to fall too much along the stage floor. The lights should be directed upwards and no direct light from the lamps themselves should strike the stage. The best type of float at present on the market (Fig. 26) is made by Messrs. Schwabe and Co., Berlin, and can be used for either direct or indirect light, the indirect arrangement being peculiarly suitable for open air scenes with a cyclorama, as there are no hard shadows thrown on to it.

Floods and Focus-Lamps.

An example of each of these has already been illustrated in Fig. 8 and Fig. 9, and the prices range from about £2 10s. to £6 10s. In Fig. 27 is shown a 17-inch

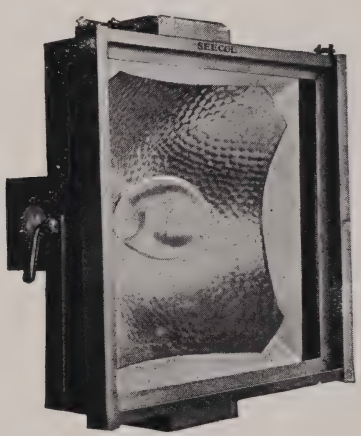


Fig. 27.
Strand Electric Co. 17-inch "Sunray" flood. 1000 Watt.

"Sunray" 1000 watt flood. The small theatres that are unable to afford such luxuries can make them for a few shillings out of biscuit boxes, with large treacle or Glaxo tins as chimneys. The grooves in the front can be made of bent metal, as shown in Fig. 28, or of wood.

The size shown is suitable for use with lamps up to 500 watts, and larger tins must be used for lamps of higher wattage. The height of chimney shown is suitable for an Ediswan lamp with a long neck, and if another make of lamp is to be used, it will be necessary to alter the chimney height. If the lamp is only to be used for flooding, the groove intended for a lens may be omitted. The special horizon floods used for domes and cycloramas are illustrated in Fig. 38. This particular design takes a tubular lamp of 1000 watts, but on very large stages the number of lamps becomes so great that a larger unit has now been placed upon the market, taking three lamps of 1000 watts each.

As will be seen from Fig. 29, the centre of the lantern is occupied by the lamps themselves, and there is room both above and below for four coloured glass slides and a metal shutter. The glass slides and metal shutter are controlled by tracker wires leading to the interlocking control mechanism shown below. This mechanical control enables the number of lanterns to be reduced, as the colours can be changed very quickly, and it is also possible to carry out the change actually during a scene, and by raising two of the colour slides at the same time, to have the top of the lantern, for example, giving blue light and the bottom half, red. This gives a greater variety of effect. The mechanical dimming also, by means of the shutter, gets over the difficulty mentioned on page 84, i.e. that the colour of the light source changes with electrical dimming.

Where a lighting pit is not used at the base of the cyclorama or back-cloth, the lights for illuminating this portion are usually concealed behind ground-rows, and a convenient form of apparatus is shown in Fig. 30. These trucks are easily drawn on and off the stage, if necessary being connected together as a train. The lamps are 1000 watt gas-filled, and the glass is similar to that used in the Schwabe horizon lanterns, but owing to the size and shape it is found advisable to use it in the form of narrow strips inserted into a metal frame.

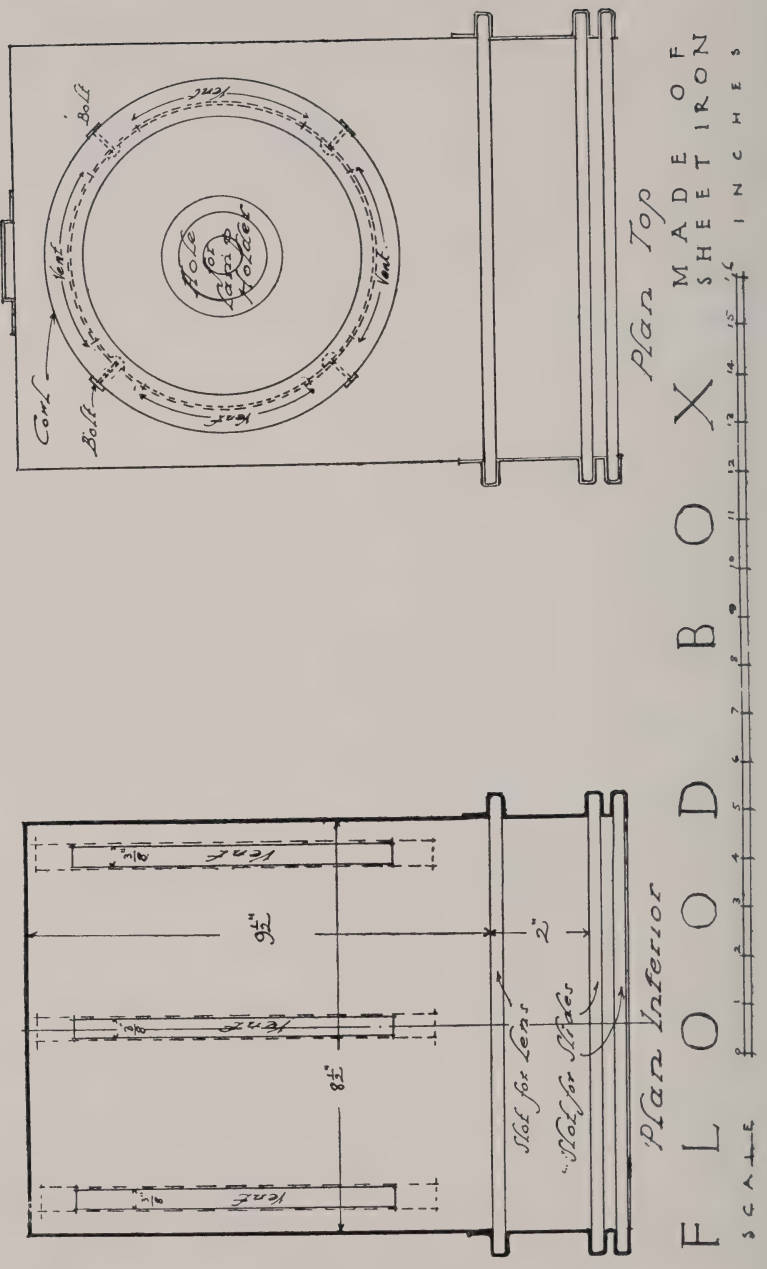

FLOOD BOX MADE OF SHEET IRON
SCALE 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 INCHES
Plan Top
Plan Interior
Bolt
Bolt
Cowl
Vent
Vent
Hole for Lamp Holder
Vent
Vent
Vent
Slot for Lens
Slot for Lens
2"
9½"
8½"

Fig. 28.

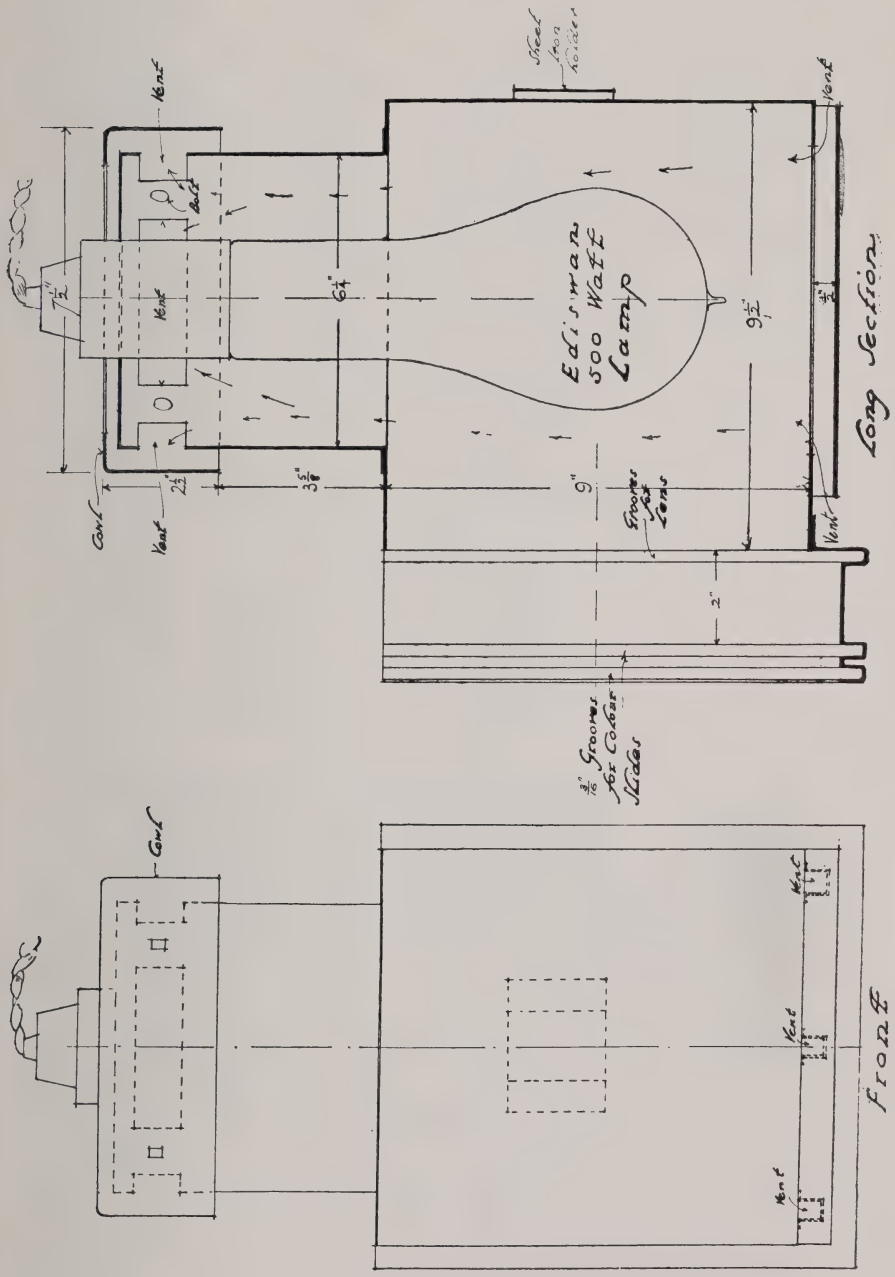

Edison
500 Watt
Lamp
Long Section
Front
Vent
Cord
Groove for Cord
6¼"
9½"
9"
2"
3⅝"
2½"
7½"

Fig. 28a.

G.E.C. 3000 watt Horizon Lantern with Colour Magazine and Mechanical Dimmer.

Fig. 29.

G.E.C. Control Regulator for operating a battery of 3000 watt Horizon Lanterns with Colour Magazines.

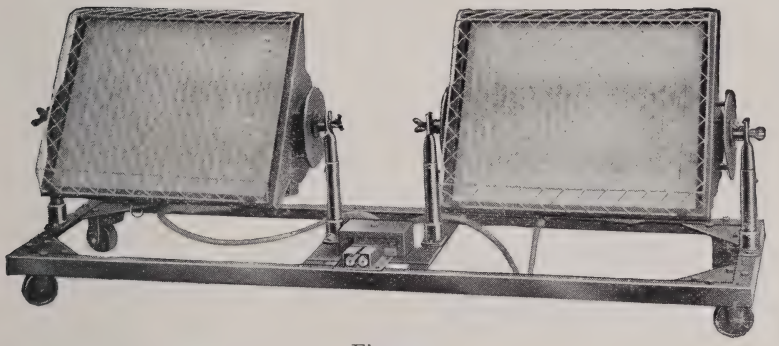


Fig. 30.
G.E.C. Mobile Ground Floods.

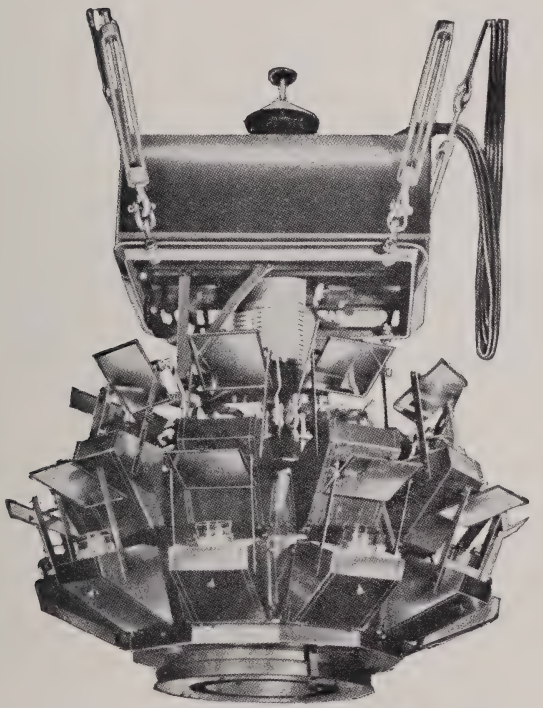


Fig. 31.
Type W.O. 20. G.E.C. Cloud Apparatus with 20 projection systems arranged in two tiers. Designed for use with 3000 watt Osram gas-filled class A.2 Projector type lamp.

G.E.C. 3000 watt Horizon Lantern with Colour Magazine and Mechanical Dimmer.

Fig. 29.

G.E.C. Control Regulator for operating a battery of 3000 watt Horizon Lanterns with Colour Magazines.

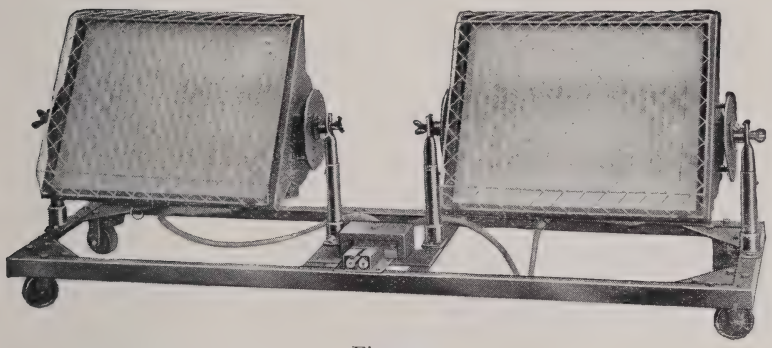


Fig. 30.
G.E.C. Mobile Ground Floods.

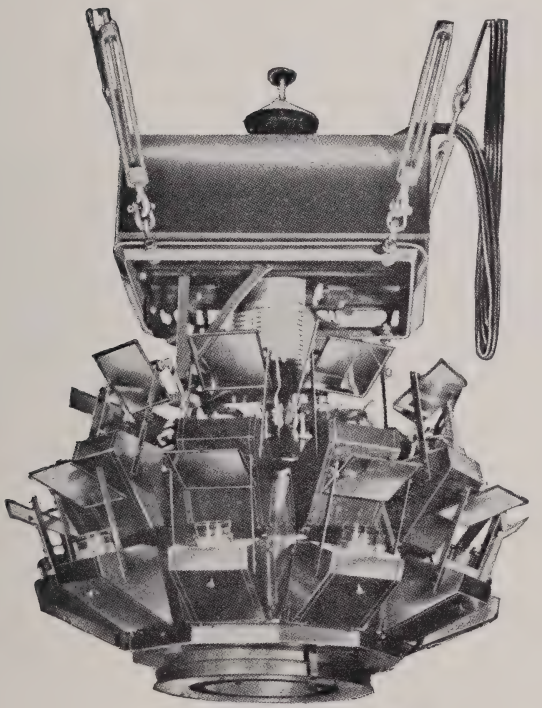


Fig. 31.
Type W.O. 20. G.E.C. Cloud Apparatus with 20 projection systems arranged in two tiers. Designed for use with 3000 watt Osram gas-filled class A.2 Projector type lamp.

The best apparatus for a cyclorama lighting-pit is the compartment type batten of large size in short sections which will allow it to take roughly the curve of the pit.

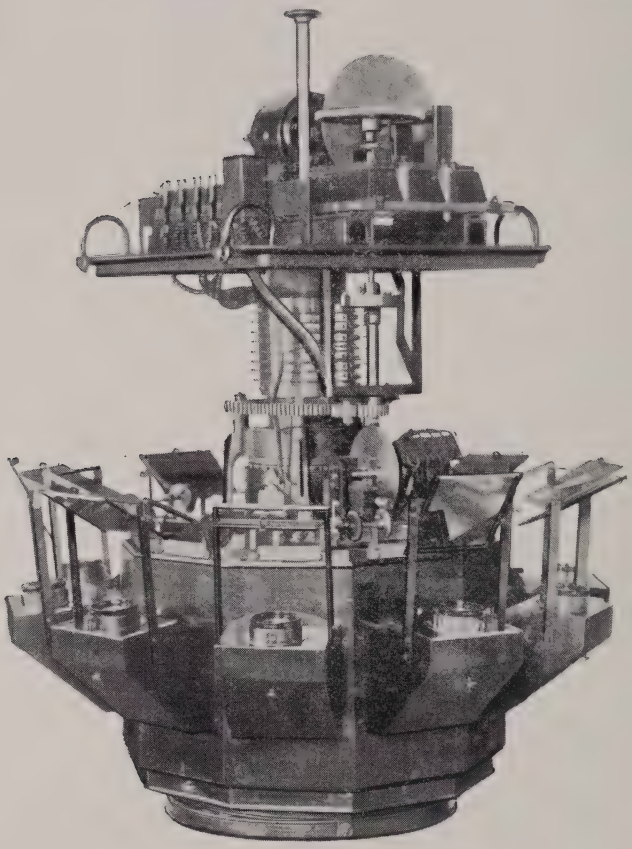


Fig. 32.

Type W.O. 10. G.E.C. Cloud Apparatus with 10 projection systems arranged in one tier. Designed for use with 3000 watt Osram gas-filled class A.2 Projector type lamp.

Cloud Machines.

The cloud machine, illustrated in Fig. 31, is the large two-tier Schwabe apparatus which is extensively used in continental opera houses and large theatres. A 3000

watt gas-filled lamp is placed in the centre, and round this are mounted twenty projection attachments, each of which can be fitted with a cloud diapositive. These diapositives are prepared from actual photographs. The

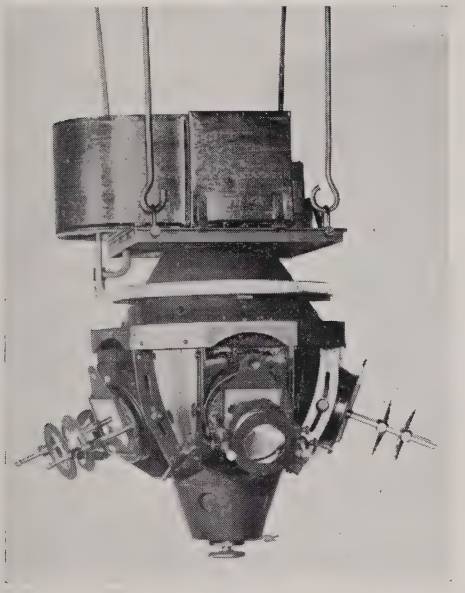


Fig. 33.

Type W.O. 5. G.E.C. Cloud Apparatus, small model with 5 projection systems arranged in one tier. Designed for use with 1000 watt Osram Cinema Clas C Projector type lamp.

clouds are made to move across the cyclorama by slowly rotating the entire apparatus by means of an electric motor. As the images from the objective lenses are reflected on to the cyclorama by means of the plane mirrors shown, it is possible to obtain a vertical movement by tilting the mirrors. The tilting movement of each tier of mirrors is worked by two electric motors. By using all three of the electric motors the clouds may

be made to move in any direction, and it is possible to make one bank of clouds move over the other.

My own view of the usefulness of this machine is that it is limited so far as realism goes to spectacular plays. Its realistic use in serious works merely distracts the audience. If, however, the machine is used by the scenic artist for purely imaginative designs which aid the atmosphere of the scene, this type of machine can become a valuable servant in the theatre. The price of £600 puts this machine out of reach of any but the largest and richest theatres, and a simpler one-tier model at about £400 is shown in Fig. 32. There are other types of machines which are to be, or have been, placed upon the market, one of which is given in Fig. 33, and costs only about £135 complete. Naturally it has a more restricted application than the larger machines, and only shows one bank of clouds moving in one direction. Clouds are easier to project than any other form of scenery or background, as the high-lights are clear glass in the diapositive and the shadows not very dense. This accounts for the relatively low candle power required in cloud machines. With the home-made variety such as that mentioned by Mr. Procter-Gregg on page 168, the principle employed is to use a "leak" of white light through a brown paper mask wrapped round a horizon type of lantern, which has the inside painted a dead black instead of using the usual reflector. This is an example of the use of "specular" projection.

Fig. 34 shows one of the latest designs of powerful arc focus-lamps. On the stand shown it is very suitable for long throw work in the front-of-the-house, and can of course be fitted with attachments for use as a projector. Such an arc runs at 50–100 amperes.

By the time my readers have reached this point they will probably be wondering what kind of lamps to buy or make, and where to place them. I will try to give some general advice, but there is no definite "best method" of lighting a stage; it depends on circumstances. A

few of the general questions affecting the issue may be mentioned:—

(i) The money available.
(ii) The free labour available.
(iii) The size of stage and auditorium.
(iv) The shape and proportions of stage and auditorium (question of fore-stage).
(v) The class of plays to be given.
(vi) Whether a permanent or temporary theatre.

Fig. 34.

G.E.C. 100 amp. Front of House Arc Lamp Projector. Mounted on heavy pedestal type stand.

The front lights are the main problem, as the centre and back units depend on whether borders are to be used or not. Various attempts have been made to do away with footlights, none of them entirely successful. In small theatres, without footlights, if the action can be kept well behind the curtain line the side lights and No. 1 batten will be sufficient. If, owing to a small stage, the action is brought forward, the light must come forward, too. A cheap way of doing this is to suspend a focus-lamp from the roof of the auditorium, say over the front row of seats, and direct a beam of light downwards on to the front of the stage. Although far cheaper than footlights, there is a risk by this method of ugly shadows under the chin and nose. Where a large fore-stage is to be used, the side lights are frequently brought forward and placed on the side walls of the auditorium. The proscenium itself should on no account be illuminated. Some illusion must always be lost when lighting from the auditorium, and ugly shadows are difficult to avoid. It is impossible entirely to conceal the sources of light from the audience, and the rays themselves are visible owing to dust particles in the air. When illuminating the main acting-area from the front-of-the-house, powerful lamps should be avoided, and such lamps made auxiliary to the ordinary systems. Some theatres are using focus-lamps from the front of the balcony, and when these are well housed and concealed and the lights not too powerful, they may remain unnoticed. It is necessary to emphasise the fact here that front-of-the-house lighting tends to flatness, and there is always a slight risk of illuminating the auditorium. A completely dark auditorium helps the stage illusion, and this should not be sacrificed without good reason. Generally speaking, avoid lighting the stage from the back of the auditorium, and, if possible, keep all light behind the proscenium, except footlights.

Focus-lamps in front of the proscenium should be fitted with a magazine of four colours, controlled by cords from the stage.

The equipment to aim at, apart from the front lighting, is:—

When using borders. Battens, with a specially powerful one for the back-cloth, combined with large floods and ground lengths.

When not using borders. A powerful No. 1 batten reinforced with spots. Large floods over the proscenium for back-cloth or cyclorama, combined with smaller floods on the ground or in a pit. Interior scenes will then be lit by front lighting, assisted by No. 1 batten, a ceiling-piece being used. For open air scenes the acting-area may be further illuminated by a large (1000 watt) lamp suspended over the centre of the stage just above the line of sight, and fitted with a deep hood to prevent too great a spread of light.

The smaller the total number of lamps used, the cheaper the installation, which is why I favour the large gas-filled lamps, apart from their other advantages. A greater number of lamps, however, gives flexibility, and when a stage has its original minimum equipment, every effort should be made to add to it from time to time. Thus a stage equipped with battens, floods, spots and footlights may later have added side and back lights from the auditorium for restrained and occasional use when demanded by a special use of the stage, or desirable in a particular play.

Chapter V

LAY OUTS—COSTS

In laying out an electrical installation points have to be considered which not only affect the ultimate cost, but also the results obtained.

Light is the most mobile part of the stage equipment, and it is as well to see that the greatest efficiency is obtained from any apparatus, however small or simple it may be.

The following examples of small stage equipment have been taken from actual installations in schools and clubs. One is from a co-educational school in Somerset where really remarkable results have been obtained by the use of reversible curtains and modern equipment.

While a great deal of fun can be obtained by making equipment, it should be remembered that there are on the market highly efficient lanterns of various types and with the latest colour screens at a low cost. This should be considered before time is spent on turning out a nice but inefficient amateur job.

There are years of experience behind the use and design of stage apparatus, and this is at the disposal of all who desire to purchase it.

It must be understood that the figures given are only approximate and vary considerably according to local conditions.

The first example given is taken from a school where there was no stage; but, when required, a section of the hall was curtained off. The batten was hidden by a short border and consisted of a length of oak 15 feet by 3 inches by 1 inch, through which holes had been drilled and the holders pushed through the back. It was wired in three circuits with flexible tails coming away to plugs. Lamps

were "dipped" for colour. The back was then covered by a piece of oak $\frac{1}{4}$ inch thick and formed a good finished job with a sheet of iron 11 inches wide painted with white enamel, as a reflector.

The footlight was constructed in the same way, but was only 13 feet in length. As there was no stage, this was placed on the floor 2 feet in front of the curtain and was also in three circuits with tails taken to plugs. The portable board consisted of 7 tumbler switches, 7 sockets, a small ironclad main switch and 4 slider type dimmers. The blue circuits were plugged in two of the "ways" which had no dimmers. Each of the other circuits in float and batten were plugged into dimming "ways," leaving one "way" for table lamps or other electric props.

Owing to the local conditions the cost of conduit and cable was eliminated, as a pair of wires were taken from the portable board to the main switch for the supply to the building, which was only a few feet away.

A 15-foot length such as the above with metal reflector of 20-gauge painted white enamel (not stoved) costs approximately £6, the footlight being shorter by 2 feet, costs approximately £5 7s. 6d.

The portable board (which can always be hired from various firms in London) costs approximately £17 10s. This figure varies according to the load and sizes of dimmers required.

Example No. 2 is taken from the school in Somerset already referred to. In this case the stage was a built platform at the end of the hall in which religious services were held. This had to be taken into account when building. There were steps permanently built right across the front, which measured about 42 feet. On the stage itself there was a grill framework fitted to the ceiling and the proscenium was formed by folding panels, which could be opened or closed at will to vary the size of the opening.

There were three 500 watt stainless unbreakable reflector flood lanterns and two 250 watt spot lanterns on

a length of iron piping fitted directly behind the grill. These formed a No. 1 batten. Each of these lanterns could be directed, giving shadow where required, and the colours could be changed during the act, thus making for greater flexibility. This method of banking units together is finding greater favour, even in the commercial theatre, as it can be added to if required without scrapping other plant, and units can be changed about as required, or used elsewhere.

The remainder of the installation consisted of two 500 watt focussing type spot lanterns on brackets in the front of the hall. These could be dismantled when not in use.

There were no footlights, and the spot lanterns proved of great value.

In addition, two flood lanterns of the same type as No. 1 on extending stands were used on the stage.

The whole of this equipment, including a ten-way switch board with nine dimmers, cables, and the erecting cost approximately £123, divided up as follows:—

		£	s.	d.
1.	Lamps complete for use	50	0	0
2.	10-way switch board (portable, on oak), with tumbler switches, plugs, sockets and 9 dimmers	54	0	0
3.	200 feet cable, plugs, etc.	7	10	0
4.	Clips and iron piping for lamps behind grill	1	0	0
5.	Erection costs	10	0	0
		£122	10	0

The labour in erecting this was not great, as again the company had a main switch with a pair of 7–20 cables on the stage, as shown in Fig. 35. There was a change over switch installed, which changed over from the decorative brackets on the stage to the stage switchboard.

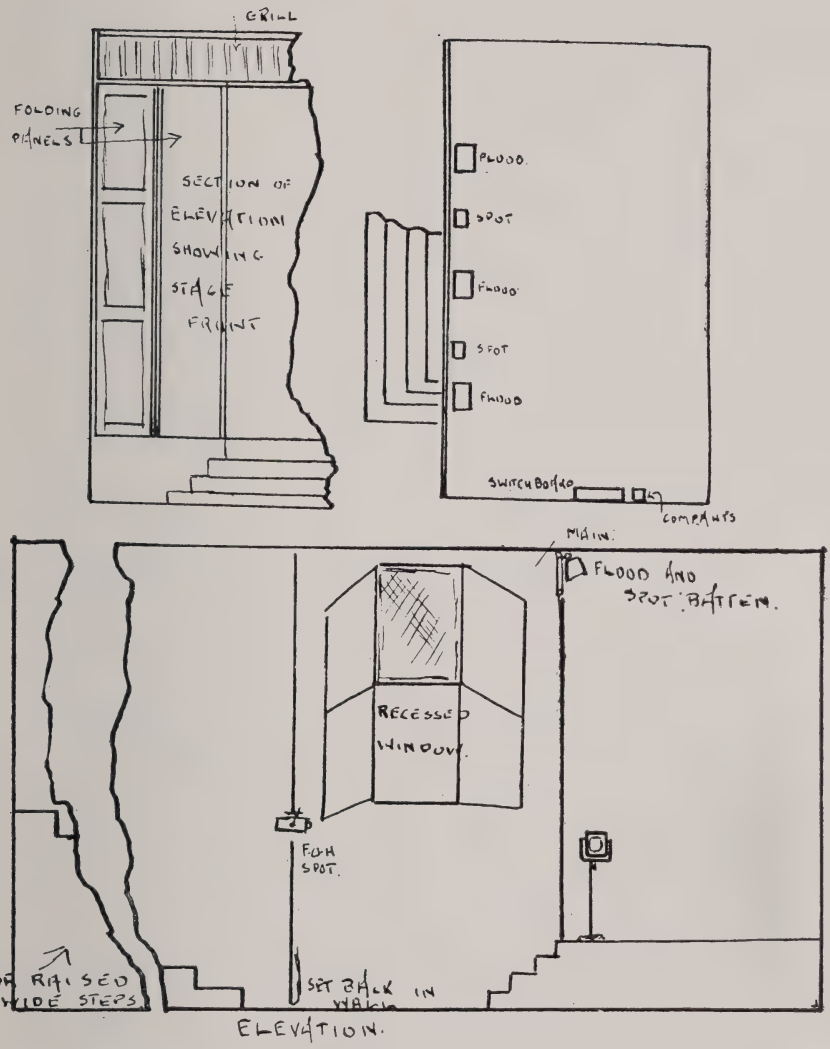

GRILL
FOLDING PANELS
SECTION OF ELEVATION SHOWING STAGE FRONT
FLOOD
SPOT
FLOOD
SPOT
FLOOD
SWITCHBOARD
COMPANYS
MAIN.
FLOOD AND SPOT BATTEN.
RECESSED WINDOW.
FOH SPOT.
SET BACK IN WALL
ELEVATION.

Fig. 35.

Another small theatre was equipped in a similar manner, except that two flood lanterns were used in place of the spot lanterns in front of the stage. These were masked to cut out the proscenium and the colour changes were controlled from the stage by tracker wires. This is a very simple method of achieving what is done in the modern commercial theatre by moving coils or electric motors.

There is not a great deal of difference in the cost of this method and that of spotting. The focus type lanterns are preferable, and if it is possible with the local conditions to put up a colour change control led by tracker wires, then it is better to use the focus type than the flood, as a great deal of time is necessary to get the correct angles of masking, and the result is not so satisfactory, as such a flood cannot be drawn to a particular focus.

Example No. 3 is of an existing small installation at a Social Club in the suburbs of London. The club has a small stage 10 feet deep by 18 feet wide, with an opening of 10 feet by 12 feet. It is fitted with a compartment type batten of 8 feet in length with 12 compartments split into 3 circuits, together with a footlight 6 feet long of 12 compartments and 3 circuits. The results fully justify the cost on installing. The average figure for this type of fitting is 50s. per foot, varying slightly according to the type of reflector used. The aluminium is the cheapest, the stainless steel next in price, and the silvered glass reflector the most expensive of the three.

The reason that this type of equipment was chosen was that certain regulations had to be conformed to, and normal theatre gear was used to prevent any alteration at a later date. The material supplied was of the best quality and required practically no maintenance, one set of lamps and gelatines lasting eighteen months, giving a soft even flood of light which could be used for both concert and play work.

The wiring in this instance was done by members of the club, who also supplied the conduit and cable, etc.

	£	s.	d.
The batten	20	0	0
The footlight	15	3	0
The switchboard of 8 ways with main switch, 8 dimmers	33	10	0

Example No. 4. The following estimate for a small theatre has been prepared by a stage lighting expert. He suggests this for stages up to 25 feet in depth with an opening up to 13 feet high by 22 feet wide.

For the front batten, a unit type consisting of 200 watt flood lanterns in white enamel or with stainless metal reflectors, alternating with focusing spot lights. Above this, and slightly further up stage, a framework of 500 watt miniature horizon lamps with glass screens similar to that shown in Fig. 38 (see p. 79). The number of these would, of course, vary according to the requirements and size of the stage, but should not be less than seven.

A footlight of the compartment type with glass reflectors.

Three 500 watt focus type spot lanterns on a bracket centre, in front of the stage, and one or two 500 watt floods and focus-lamps on stands or fixed to the inside of the proscenium for general stage use.

The wiring for this type of equipment should be to plug points. This entails a certain extra cost but gives greater flexibility.

The cost of this would of course depend on sizes and quantities, but the following list would be a guide:—

		£	s.	d.
1.	Lamps ready for use (7 horizon lanterns costing £28)	86	0	0
2.	Iron piping with hanging irons ..	4	0	0
3.	Portable board with slider type dimmers (say 14 ways)	56	0	0
4.	Wiring and labour	100	0	0
5.	Various extras	25	0	0
		£271	0	0

This means that if you have the current laid on to a position on the stage, you can get a good installation, sufficient for interior and exterior scenes in a small theatre for £200 to £300, and if used to its maximum, results that would surprise many of our commercial theatres.

It is worth mentioning in passing that the atmosphere near the sea is unsuitable for aluminium reflectors.

In leaving these very small theatres and passing to the next class, a useful guide to total expenditure may be given in advance of the actual figures. It will generally be found that if the catalogue prices of the lamps, dimmers and switches required is totalled up, the same sum will need to be added for the extra material required in the way of cable, conduit, distribution boards, etc., and labour, the last being a very heavy item.

Example No. 5. The Festival Theatre, Cambridge, which is described elsewhere, represents the luxury type of "Little" theatre; actually it may be said to stand midway between the Little theatre and commercial theatre. The table below gives an idea of the cost that may be expected in equipping such a theatre. (For obvious reasons I do not wish to quote the actual figures.)

	£	£
Lamps Complete	250	to 300
Wiring, tubing, dis-boards	250	,, 300
Switch-Board and dimmers	250	,, 300
Front-of-house decorative	200	,, 250
Dressing-rooms and understage, etc.	75	,, 100
Labour on all	975	,, 1000
Total	£2000	,, 2250

Example No. 6. The illustration in Fig. 36, shows a typical modern kinema lay-out. For theatrical purposes the stage would, of course, have to be far deeper. The costs also would have to be modified considerably, and I have therefore given no figures in detail.

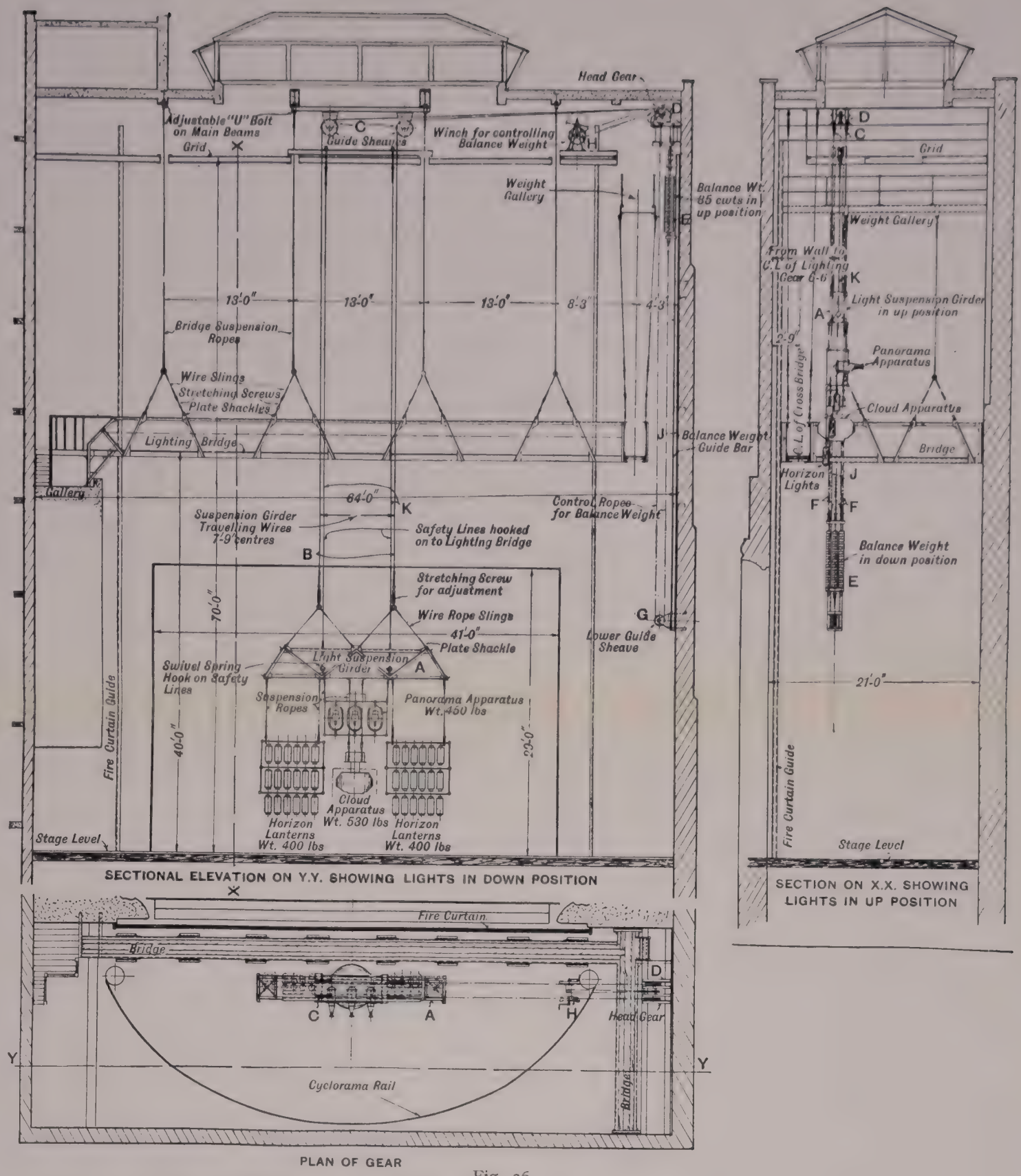


Fig. 36.

G.E.C. Arrangement of Schwabe Lighting Apparatus with suspension gear for cyclorama lighting as at the Plaza Theatre, London.

A full-size theatre lay-out, including such apparatus as that shown here, might cost £10,000–£12,000.

Example No. 7. A large continental Opera House with huge stage, several cycloramas, and every possible modern invention and luxury, such as we see at La Scala, Milan, the Charlottenberg Opera House, Berlin, and so on, might cost from £20,000 to £40,000 to equip completely with electrical gear.

Chapter VI

PRINCIPLES OF STAGE LIGHTING

In the very early days of artificially-lit stages, every available place where a light could be put was utilised. The front edge of the stage offered an opportunity for accommodating a large number of lights in a place where they could be easily shaded from the audience and throw the maximum light on the faces of the players. This row of lights came to be known as the *floats*, because they were at one time wicks floating in oil. The word is still used, although footlights is a term better known to the public.

This use of footlights was a perfectly legitimate device originally because of the difficulty of getting light at all, but the light came from a very unnatural direction and produced some curious shadows and other bad effects. Many years passed under these conditions and "the glare of the footlights" became an accepted fact which no one bothered about.

With the advent of gas it was possible to put more light on the stage, particularly from above by means of gas battens. The introduction of the limelight helped in back-cloth effects, spot lighting, and light projection from the back of the auditorium. The footlights remained as before, the oil lamps being replaced by gas burners, probably because no one thought about doing anything else.

I should like to remark in passing that some of the gas lighting, particularly by Irving, compared favourably with much electric lighting seen on the London stage to-day.

Gas lighting had many disadvantages; unpleasant fumes, great heat, and danger of fire being some of them. It had one advantage over electricity—it was easy to alter the intensity of light on the whole stage or a portion of it by merely turning the gas taps on or off. With electric light the dimming apparatus is both elaborate and expensive.

Electricity began the revolution in stage lighting. It has been a much slower business than it ought to have been; just as oil lamps were changed to gas burners, so gas burners were changed to electric bulbs, and the "glare of the footlights" went on.

The use of limelight has continued even up to the present day in London theatres.

The greatest advance of recent years is the perfecting of the gas-filled lamp of high wattage (frequently called half-watt lamps).

Shadows.

In the very early days it was impossible to avoid ugly shadows on the stage, but with the advent of gas lighting it was possible to distribute the light so evenly that all shadows were "killed." It was then that the appalling practice developed of *painting* the shadows on the scenery. This can never be anything but a source of irritation to an audience.[1] Unnatural shadows and the absence of shadows have become stage conventions like the glare of the footlights. It must be pointed out that it is very easy to kill a shadow by throwing another light on the place where the shadow falls. When it is remembered that the audience expects to be able to see the features of the actors, necessitating lighting from the front, it becomes apparent that it is very difficult to do away with some sort of conventional arrangement. At the present day the general practice is to work with a shadowless stage for most general

[1] I am not here referring to the quite legitimate device of painted shadows and high lights to give depth to oak panelling and such like, but the larger stage effects.

scenes, but modern apparatus has allowed a softer and more pleasing effect.

It is impossible to light an interior scene naturally from a window at the back or side, as the actors' faces would be in shadow when looking towards the audience from the front of the stage. It may be possible to make the scene *appear* to be lit from a window by first illuminating the stage in such a way as to show the actors' faces and at the same time to kill shadows, and then by throwing sunlight through the window, to superimpose natural shadows on the original lighting, but in the little theatre the powerful lamps necessary may be lacking. The usual course is to work without shadows.

In doing this great care must be taken not to allow the footlights to be too powerful, as the effect is to illuminate the underside of tables and chairs in a very unnatural manner. Actors sitting cross-legged on chairs near the footlights will show boot soles brightly lit. There will also be ugly lights on the underside of chins and in the eye-sockets, and the floor will be unduly prominent. It is far better to light more from above, *and especially from the sides*, and to use the footlights as a corrective only. The side lights may well be floods, placed as near the proscenium as possible.

In open-air scenes natural shadows are almost impossible except in very large theatres. The reason is simple. The source of light is so near the actors that, as they move about the stage, the direction and length of their shadows will vary. This is so opposed to nature as to be absurd. In large theatres it is sometimes possible to place a very powerful lamp at such a great distance from the stage (say directly under the grid in a far corner), that the variation in the shadows is hardly noticeable. In this case the lamp may be 150 feet from the nearest actor.

Balancing Lights.

No matter what the system may be, the various parts of it must be properly "balanced," and it may be a

surprise to many to learn that by far the greatest candle-power is needed for the back-cloth lighting in open-air scenes.

It is well to consider the acting-area lighting as separate and distinct from the back-cloth lighting. When the sky is represented at the back of the stage, it is imperative that no shadows of actors or scenery appear on it. In order to kill such shadows it will be found that powerful lights are needed, especially as the stage may be illuminated by a light colour, such as pink, in front and require a dark colour, such as blue, at the back. It is difficult to lay down a definite rule as to the proportion of power required, but as a rough guide the back-cloth will need about the same power (in watts) as the whole of the acting-area, and sometimes more.

In order not to kill the back-cloth effects, all acting-area lighting should be directed in such a way as not to strike directly on the back-cloth. The footlights should be sunk in a trough or so arranged that the direct light from them just misses the top of the back-cloth, acting area lights from above should throw light vertically downwards, and side light should be directed across diagonally to the opposite side of the stage. If all these lights were allowed to strike the back-cloth, it would need twenty times the power of such lights to kill all shadows upon it.

Naturally the further the back-cloth or cyclorama is from the acting-area, the easier it is to carry out these conditions. To get the full benefit from the cyclorama there should be a distance of 10 *to* 30 *feet between it and the back of the acting-area.*

The balancing of the acting-area lights themselves is of importance. The front lights, whatever they may be, should be sufficiently strong to light the actors' faces, and the remainder sufficiently strong to neutralise (if necessary) the shadows cast by the former.

To give some idea of the relative intensity of light required for this, I give a sketch-plan of a stage assumed to have an acting area roughly 16 feet square. In the

divisions of the stage formed by the borders I have placed a figure to represent the total wattage of the lamps used therein. (See Fig. 37.)

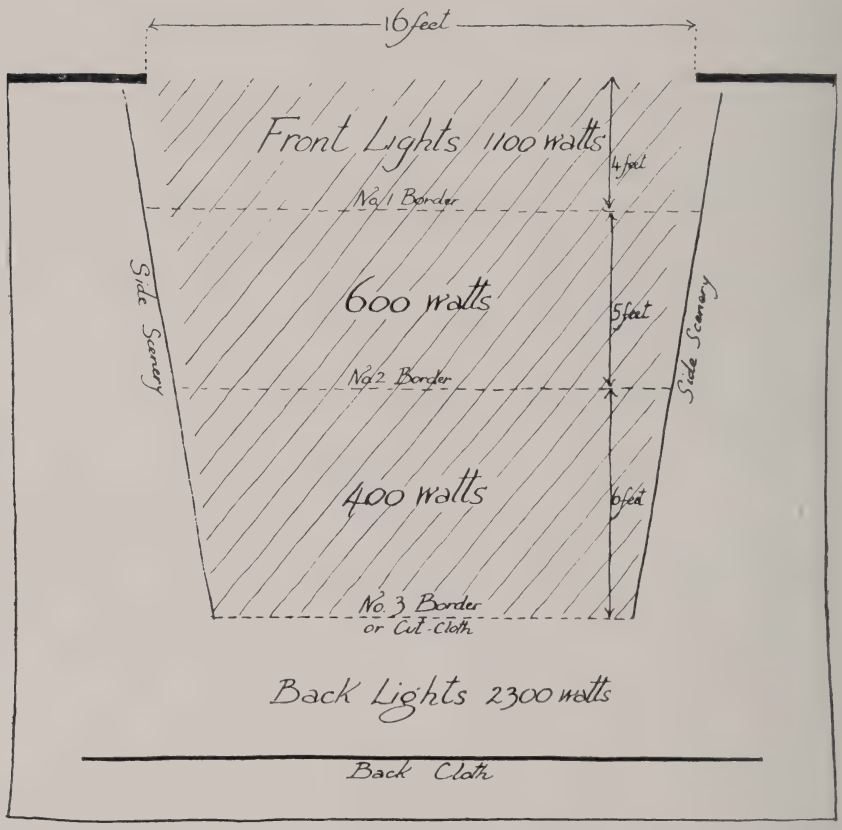


Fig. 37.

In order to carry out this idea the lamps may be arranged in such sizes as to give the relative wattage, or they may be balanced as desired, using dimmers. The latter method is the better, and gives fineness of adjustment, but many little theatres will be unable to go to the trouble or expense of providing them.

Special Cases.

We may now consider a few special cases where natural shadows and lighting are possible.

1. Interiors where the action is limited to a small section of the stage and very few characters. For instance, a prison cell, which may be lit by a beam of light directed through the window or grating on to a solitary occupant; or a bedroom, where the light is directed on to the bed, and around which a limited number of actors may be placed.

2. Silhouette scenes. These can be arranged against a sunset back-cloth or other illuminated background. This arrangement makes the setting very simple and inexpensive, as the details remain invisible, but it must be pointed out that the action must be simple and short and the characters already familiar to the audience. It is well known that it is almost impossible to retain the attention of an audience for long unless they can see the actors clearly. (See Fig. 65.)

3. Interiors showing a limited amount of open space through doors or windows. *Example*—A tent scene through the open door of which a sentinel is seen passing at intervals in the moonlight. Here the moon (invisible, of course) is represented by a large lamp which throws a deep shadow of the sentinel on the ground. His beat is relatively so short that the alteration in the length of his shadow as he moves will be unnoticeable.

4. Open-air scenes may occasionally be lit in this manner when there is no movement to betray the nearness of the source of light.

The Use of Coloured Light.

I condemn the use of coloured light merely to gain a pretty effect. Coloured light should be used for two purposes:—

(i) To represent the light of nature, and, or,
(ii) To aid the atmosphere of a play.

In both cases the light should be used to do away with painted scenery as far as possible. The question of psychological lighting, suggested by case (ii) above, will be considered later.

Primary Colours—Colour Mixing.

White light (north day-light) may be said to consist of a mixture of these colours:—

Red
Orange
Yellow
Yellow-green
Green
Blue-green
Blue
Violet.

The above list is probably a convenient one for theatrical purposes. It is not often that pure colours are met with, but it is possible to prepare them, and the use of such colours is increasing in the theatre. The pioneers in the preparation and use of these colours are Messrs. Schwabe of Berlin. The practical working of their seven colour process of theatre lighting may be considered one of the outstanding scientific achievements of the present time.

The difficulties that confront any experimenter in this field are of a three-fold nature. First, to obtain a reasonably pure colour filter; that is, a filter that will pass light between given wave-lengths. Secondly, to prepare it in a form that will withstand the intense heat of a high power lighting unit; and thirdly, to obtain a filter that will not fade during prolonged use. Theoretically this has not yet been achieved, but in practice the conditions are so nearly fulfilled by the Schwabe battery of lamps that their use is universal in Germany, with most excellent results.

In German theatres using cycloramas the lighting comes from a battery of Schwabe lamps situated above the proscenium. The lamp itself is illustrated in Fig. 38.

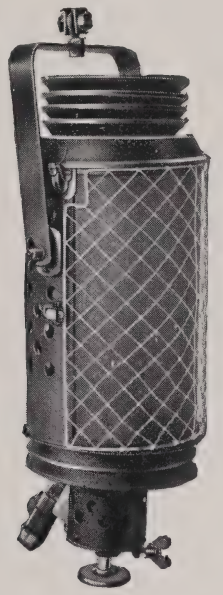


Fig. 38.
G.E.C. Horizon
Flood Unit.

It consists of a circular metal housing, with a polished aluminium reflector, containing a tubular gas-filled lamp with an elongated 1000 watt filament. A semi-cylindrical filter of frosted glass is fitted to the front of the lamp and the light is evenly distributed through an angle of 180°. A wire grid protects the glass, and incidentally the people on the stage below in the event of a breakage. Before giving details of the actual filters used it must be impressed upon the reader that the colours are supposed to be used in combination, and the fact that some of them are individually unpleasant does not detract from their value.

There are seven colours, usually used in combination, as follows:—

Dark Blue. This is a peculiarly vivid violet blue which is exceedingly beautiful in itself. It is the most commonly used of all the Schwabe colours, but owing to its density only a small proportion of light passes through, and more lamps fitted with these colours are needed than in the case of the others.

Middle Blue. This is a decidedly greenish blue. It is not very attractive in itself, although used alone it is a useful moon-light colour. Its chief use is in combination with the dark blues to produce a resultant lighter blue.

Light Blue. This is a bluish green, and by itself an unpleasant colour. It is never used alone, but only in combination with the dark blues and, or, middle blues to produce very light summer skies and similar atmospheric effects.

Day-light Blue. It is not necessary to say anything about this colour except that it is ordinary artificial north day-light. It is only used to dilute the other colours or combinations, and these lamps are used less than any other colour in the set.

Green. This is the least satisfactory colour in the Schwabe system. It is a very unpleasant yellowish green and unsuitable for use by itself. It is used principally in conjunction with the blues to produce dark and stormy atmospheric effects, and also neutral greys of a varying tone.[1] The unpleasantness of the colour is no disadvantage where realistic effects are desired, but in imaginative productions modern producers frequently desire an emerald-green background on the cyclorama which it is at present impossible to obtain. The reasons for this are purely technical ones. No glass manufacturer is able to produce the true emerald green glass, and any other medium, such as gelatine, refuses to stand up to the intense heat and light conditions.

Yellow. This is a very perfect and pure colour and is used by itself or in combination with the red for ambers

[1] Dark blue 80 per cent., Middle blue 80 per cent., Green 65 per cent.

and oranges, and in combination with the blues for dawn and sunset atmospheres.

Red. This is also a fairly good colour, though somewhat on the pink side. It is used principally with the

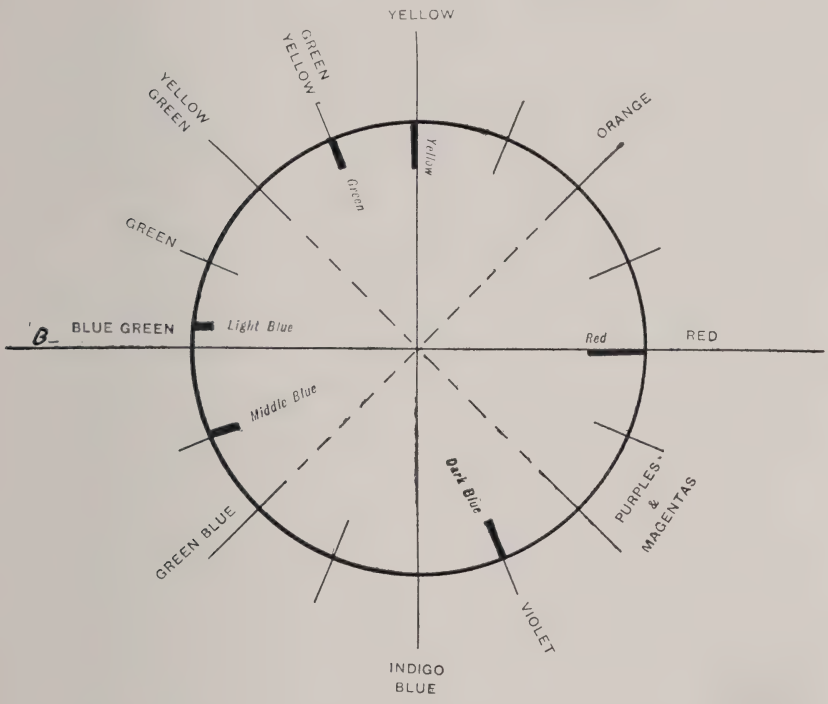


Fig. 39.

The names inside the circle in italics show the Schwabe colours mentioned on pages 80 and 81. Special colours can be supplied by Schwabe such as optical blue (nearly indigo), a yellow-green corresponding with that colour above, etc., etc.

blues to produce purple, for warming up the yellow light, and is introduced into other combinations to give depth and warmth.

All these filters are made from what is known as "pot-fused" glass, with the exception of the red, which is gold "flashed" glass. A reference to the colour-wheel (Fig. 39) will help the reader to grasp the principles of colour mixing. It will be seen that the chief colours are blue, green, yellow and red. Colours at opposite

diameters of the wheel when combined give white light ;[1] that is yellow and indigo blue or blue-green and red. The colours indicated between these are the resultant of the two adjacent principals, that is yellow and red when mixed together give orange, green and dark blue give green-blue, and the green-blue and orange together will also give white.

Theoretically, if the seven Schwabe colours were pure spectrum colours every conceivable colour, tint, and shade known to the artist could be obtained on the cyclorama by mixing the light from the various lamps, and although in practice this is not fully realised, an almost unlimited range is at the disposal of the producer. The combinations which are possible with these lamps run into many millions, and I regret that there are no tables available which give to the beginner a guide in using them.[2] I give a table later on, however, showing the colour combinations possible in a three-colour process. It is necessary to remind the reader here that the eye alone is very often deceived in judging colours, and what may appear to be orange, for instance, on analysis with the spectroscope turns out to be a mixture of red, green and yellow. In obtaining colours by mixing lights, the mind must be kept free from thoughts of mixing pigments. The former is an additive process and the latter a subtractive one. Thus the additive mixture of primary colours tends to give white light, whereas the subtractive mixture of similar pigments tends to give black. The visible spectrum can be divided into two portions, each complementary to the other. A body tinted with the colours in one portion and illuminated by the other appears dark to the eye because it absorbs the incident light. On the other hand, when illuminated with light of its own colour, total reflection occurs and the body apparently disappears. It will be noticed upon examining the spectrum of north day-light that the principal colours are blue, green, and red ; and if these three colours

[1] Such white light has different effects on coloured objects to true white light (day-light). The effect differing with the component rays.

[2] With 7 colours assuming 10 dimmer positions for each colour, the number of combinations is 19,487,170.

are carefully chosen they will, when combined, give a white light. In other words, they are complementary to one another. A fuller list of complementary colours with their wave-lengths may be interesting:—

Red	λ 656 and	Blue-green	λ 492
Orange	,, 608 and	Blue	,, 490
Gold yellow	,, 574 and	Blue	,, 482
Yellow	,, 567 and	Indigo blue	,, 464
Green yellow	,, 564 and	Violet	,, 433
Green	,, 524 and	Purple obtained only by mixing red and blue.	

Coloured glass is the only medium at present available which can be depended upon to keep its colour without fading. At the Festival Theatre, Cambridge, a three-colour process is used for lighting the lower portion of the cyclorama, the lamps being arranged in a pit below the level of the stage. The Festival Theatre is supplied by Messrs. Hetley, of Soho Square, London, who supply a blue glass known to them as 21 oz. cobalt blue, and this will combine well with their red and green rolled glass. (The blue glass on prolonged usage with powerful lamps shows a tendency to fade.) Of the other two colours, the green is rather too yellow to be pleasant when used alone, but does not fade. The red is an exceedingly good colour, giving a deeper and better effect than the Schwabe red. There is also no tendency to fade. In the Festival Theatre battens the same red and green glass is used in combination with the less intense rolled blue.

Summarised, the advantages of using the coloured glass are:—

1. The ease of obtaining a large variety of colours by switch-board control.
2. Saving of expense in gelatine mediums, as the glass lasts indefinitely except for accidental breakage.

A disadvantage is that this glass cuts off a greater percentage of the light than gelatine mediums. In effect this is so serious that lamps of double wattage

should be used when substituting glass for gelatine. The current consumption will be three or four times as great as when using gelatine.

The following table will give some idea of the colour combinations that have been found possible on the lower portion of the Festival Theatre cyclorama, the circuits being arranged as follows:—

Seven lamps of 300 watts each, fitted with Messrs. Hetley's 21 oz. cobalt blue glass.
Eight lamps of 250 watts each, fitted with Hetley's rolled red glass.
Eight lamps of 200 watts each, fitted with Hetley's rolled green glass.

The lamps are arranged alternately in a pit round the cyclorama, below the level of the stage. There are three dimmers, one controlling each circuit, the dimmers themselves being graduated from 0 to 100, so that the figures in the columns marked red, blue, and green, represent the actual position of the dimmer controls as percentages. It must be noticed, however, that although the dimmer of position 100 per cent. means that the lights on that circuit are full on, and the position of 0 per cent. means that the lights are out, it does not follow that the dimmer position of 50 per cent. indicates that half candle power is available in that circuit. The position of 50 per cent. probably indicates that the candle power has been lowered to about 25 per cent.

Another matter that has to be taken into consideration when dealing with gas-filled lamps is that as the filament of the lamp is dimmed down it alters in colour from nearly white to red, so that any such electrical dimming changes in the colour of the lights are not the same as they would be if the light were dimmed by mechanical shutters passing over the lamp.

This change in colour of the light source as well as its intensity accounts for what appear to be mysterious departures from theoretical colour mixtures on the cyclorama. Thus the Schwabe dark blues at 100 and greens at 80 may give a green-blue, but with blues at 80

and greens at 64, a neutral grey may result instead of less intense green-blue.

The column marked "Colours Produced" shows the change that takes place when two of the circuits are in a fixed position while the other circuit is run in from 100 to 0, or vice versa. In order to economise space I have only tabulated the position of the dimmers differing by 20 per cent. This gives sufficient indication of the general trend of the three-colour process, and I do not claim to do more for the reasons that it is not easy to borrow a full-size and busy stage for protracted experiments, and the strain on the observer's eyes is so great that after a few minutes' work it is most difficult to distinguish fine shades of colour.

In passing I may remark that a table such as this is difficult to compile owing to the paucity of our colour language.

From Experiments by C. Harold Ridge and Leslie Steen at the Festival Theatre, Cambridge.

Red.	Blue.	Green.[1]	Colours Produced.
100	0 to 100	100	Yellow—Pinkish white.
100	100	100 to 0	Pinkish white—pink—magenta.
80	100	0 to 100	Purplish magenta—bluish pinks—pinkish blue—greenish white.
80	100 to 0	100	Greenish white—light green—yellow green.
60	0 to 100	100	Yellow green—blue green—light blue white.
60	100	100 to 0	Light blue white—light purple.
40	100	0 to 100	Dark purple—light blue—blue green—green white.
40	100 to 0	100	Green white—light green—yellow green.
20	0 to 100	100	Yellow green—blue green—light blue—very light blue.
20	100	100 to 0	Very light blue—light blue—blue.
0	100	0 to 100	Blue—light blue—blue white—green blue (moonlight).
0	100 to 0	100	(Moonlight) green blue—green.

[1] This glass is not a pure green, such being at present unobtainable.

Red.	Blue.	Green.[1]	Colours Produced.
0 to 100	100	100	Green blue—pinkish white.
100	100 to 0	100	Pinkish white—green yellow.
100	0 to 100	80	Orange—pink—light purple or light magenta.
100 to 0	100	80	Light purple or light magenta—light blue.
0 to 100	100	60	Light blue—light purple—dark pink.
100	100 to 0	60	Dark pink—light red—dark amber.
100	0 to 100	40	Red—magenta—light purple.
100 to 0	100	40	Light purple—light blue.
0 to 100	100	20	Blue—purple—magenta—dark pink.
100	100 to 0	20	Dark pink—red.
100	0 to 100	0	Red—dark pink—magenta.
100 to 0	100	0	Magenta—purple—blue.
100	100	0 to 100	Magenta—dark pink—light pink—pinkish white.
100 to 0	100	100	Pinkish white—green blue (moonlight).
0 to 100	80	100	Light green—yellow green—yellow.
100	80	100 to 0	Yellow—light pink—dark pink—magenta.
100	60	0 to 100	Red—amber—light amber—dirty yellow green—yellow (all bad colours).
100 to 0	60	100	Green yellow—light green.
0 to 100	40	100	Light green—yellow green—yellow.
100	40	100 to 0	Yellow—orange—red.
100	20	0 to 100	Red—orange—amber—yellow—green yellow.
100 to 0	20	100	Green yellow—light green—green.
0 to 100	0	100	Green—yellow green—light yellow.
100	0	100 to 0	Light yellow—yellow—orange—red.
90	100	100	White (equal to Schwabe daylight-blue).

[1] This glass is not a pure green, such being at present unobtainable.

In case the above table is not clear, I here give another arranged differently. The colours are put in roughly the spectrum order with the dimmer settings against them to give approximately that colour with maximum luminosity.

DIMMER SETTINGS FOR MAXIMUM LUMINOSITY.

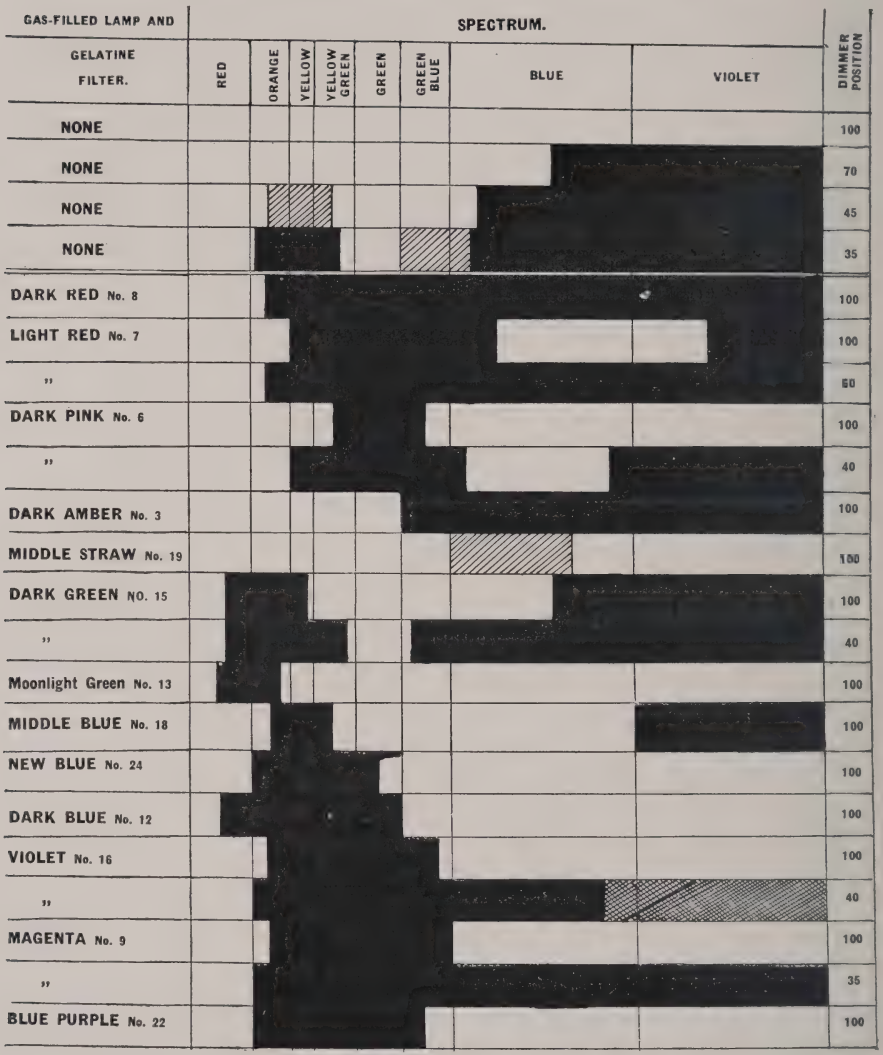
		R.	B.	G.
BLUES.	Purples	55	**100**	30
	Violet	50	**100**	0
	Dark Blue	0	**100**	0
	Blue	20	**100**	25
	Light Blue	30	**100**	55
	Green-Blue[1]	0	**100**	**100**
GREENS.	Blue-Green	40	75	**100**
	Green[2] (yellow-green)	0	0	**100**
	Light Green (purer)	35	55	**100**
	Yellow-green	50	10	**100**
	Green-yellow	95	20	**100**
REDS.	Yellow	**100**	25	95
	Amber	**100**	10	75
	Orange	**100**	20	60
	Pinks	**100**	85	70
	Magenta	**100**	90	15
	Light Red	**100**	50	60
	Red	**100**	0	0
	White	90	100	100

[1] Greys by dimming (about equal mixtures of blue and green).
[2] This glass is not a pure green, such being at present unobtainable.

TESTS OF GELATINE AND GLASS (THEATRICAL) COLOUR FILTERS.

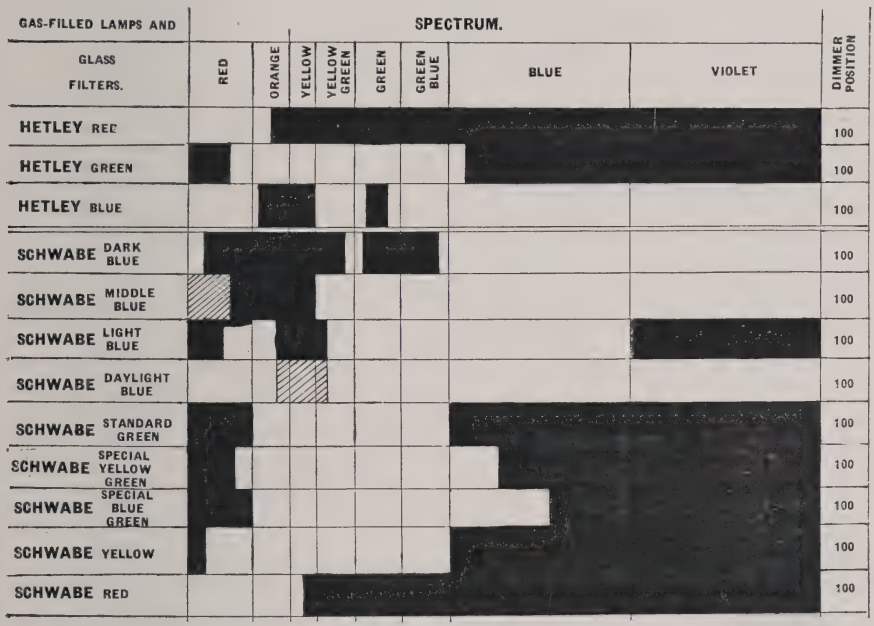
These tests have been carried out by Mr. Leslie Steen, Electrician-in-charge at the Festival Theatre, Cambridge. The source of light was in every case a 1000 watt gas-filled lamp, and in some cases this lamp was dimmed electrically to show the consequent change in the colour of the light passing through the filter, due to the alteration in the filament colour. The figure in the last column of the table below shows the actual dimmer position as a percentage. It must be understood that these results are *qualitative* only, being obtained by a direct vision prismatic spectroscope. A true spectrum analysis would be a lengthy and expensive operation, and it is doubtful if the results would justify the undertaking. Nearly perfect colour filters can be manufactured

in gelatine (e.g. Wratten photographic filters, etc.), but are difficult to make in glass; indeed for purely



visual (theatre) purposes, such accuracy is actually undesirable, because the eye is unable to detect more than the predominating colour, and to filter out all the

remaining rays means a loss of valuable luminosity. A red filter may transmit violet, red, and orange, but the red ray alone is visible as colour. In the same way a yellow filter may transmit orange and green, and a blue transmit green and violet, whilst the yellow and blue alone are visible as colour. For colour mixing purposes a more accurate filter is required, and the Schwabe glasses give a sharper "cut-off" than the



gelatine, though this may not be so obvious in the following table as a *quantitative* test would make it.

It is interesting to note that none of the gelatines cut off all the red, and that of the glasses only the Schwabe standard green and blue green do so completely.

The above tables should be examined in connection with those in Chapter IX, when some of the unexpected effects will be explained. Thus middle blue No. 18 is found to be good with all colours, and on looking at the spectrum we see it passes all rays except pure yellow

and violet, thus enabling all colours to reflect some rays of their own colour. Blue is the dominant colour diluted with a large proportion of others; we therefore get a visual sensation of light blue. Again middle straw is seen to be a mixture of all colours with excess of blue removed.

The colour of the glass filters is obtained by the addition of the following mineral substances during manufacture:—

Blue glass by adding cobalt oxide.
Green glass by adding chromium oxide or iron oxide.
Yellow glass by adding iron oxide or silver.
Red glass by adding gold, copper or manganese.

The gelatine filters are generally coloured by some dye soluble in water. Other patent mediums are made by colouring such compound as acetyl-cellulose with coal-tar derivatives.

COLOUR NOMENCLATURE.

There *is* now a simple scientific colour language, although I have not dared to use it in this volume. I strongly recommend my readers to study Mr. J. W. Lovibond's book mentioned in the bibliography, but it may be a good thing to give a general idea of its contents.

The theory is briefly as follows:—Of the six colours in white light — red, orange, yellow, green, blue and violet — red, yellow and blue are regarded as dominants, because they visually hold the associated colours, orange green and violet, in subjection. An equivalent unit of pure red, pure yellow and pure blue is adopted and incorporated into glass. The unit is multiplied to obtain greater intensities and divided to obtain lesser intensities. The coloured glasses are called absorbents. The red absorbent transmits violet, red and orange, but the red ray alone is visible as colour until the other absorbents are superimposed and the character of the group of rays changed. In the same way yellow

transmits orange and green, and blue transmits green and violet, while the yellow and blue alone are visible as colour. Orange, green and violet are here called subordinates, which may be developed as follows:—

Or. = R. + Y. Gr. = Y. + B. Vi. = B. + R.

Twenty-five years' experience in the application of the theory has given no reason for change. It must be grasped at once that light is viewed after passing through these mediums and the process is therefore an absorbtive (or subtractive) one, whereas the three colour process which has just been described at the Festival Theatre is an additive one.

The method. The colour composition of any object may be measured by superimposing units of different colours until the colour of the object is matched. A convenient apparatus is furnished for this purpose at a very small cost, and the composition of the colour is recorded by merely reading the markings on the glasses.

A more elaborate colorimeter with all the necessary glass slides arranged in an easily used form can be purchased from Messrs. Tintometer Ltd., 1, The Friary, Salisbury, for £25 complete. This instrument is already in general use. It is used in various industries, particularly dying and printing and in paint, oil and varnish works. It has been of great value in the laboratory for analytical colour estimations, and if its use extends as it should, it will greatly facilitate the recording of colours and obviate the storing of samples.

It has already been seen that the superimposition of any two colours developed a third which apparently had no relation to either. The superimposition of a third glass modifies or destroys all colour and reduces the amount of light. In this way a given neutral grey is matchable by a combination of equal units from the three standard scales, thus:—

3.0 R. + 3.0 Y. + 3.0 B. develop 3.0 units neutral tint.

In this system colour names are simplified and there

are no puces, purples, magentas, etc., which so frequently mean something quite different to various individuals. As an example of this, a magenta *might* be described as a red violet of standard brightness in which red preponderates by one unit and is matched by 4 units red and a blue of 3 units and would be described by R. 1.0 + V. 3.0.

The colour names are arranged as follows:—Single sensations as red, yellow, blue, matched by a single glass, the depth of colour being indicated by the value of the glass used. The single sensation colours orange, green and violet are matchable by a combination of equal units from two of the standard scales, the depth of colour being directly indicated by the unit value of either of the glasses, thus:—

2.0 B. + 2.0 R. develop 2.0 units violet.

The complex colour sensations, red and yellow oranges, yellow and blue greens, blue and red violet, are matchable by unequal glasses from two of the standard scales.

The colour developed is not directly indicated by the unit value of the glasses, but is recorded by means of an equation, the first half of which contains the separate values of the glasses used, and the second half the names and the depths of the colours they transmit; for instance:

Standard Glasses.			Colour developed.	
Yellow.	Blue.		Green.	Yellow.
3.0	+ 1.5	=	1.5	+ 1.5

The colour developed is a yellow green in these proportions. A complete list of colour names is therefore:—

Red	Red Orange.
Orange	Yellow Orange.
Yellow	Yellow Green.
Green	Blue Green.
Blue	Blue Violet.
Violet	Red Violet.

This is all that is necessary to describe any possible colour, provided that we add or subtract a neutral tint. The standard glass colours are necessarily of a given brightness, and colours for measurement may be either brighter or sadder than the standard. A given complex colour of less than glass standard brightness is matchable by unequal numbers from the three standard scales; the smallest unit value always represents a neutral unit factor, as follows:—

Standard Glasses.				Colour developed.		
R.	Y.	B.		Neutral	G.	B.
1.0	+ 3.0 +	9.0	=	1.0	+ 2.0 +	6.0

The colour is a blue green in the proportion of 6 to 2 saddened by one neutral tint. A given complex colour of greater brightness than the glass standard is first dulled by the interception of neutral tint units until measurable in the manner described above.

It will be seen by this method that any colour can be described both qualitatively and quantitatively, and the result reduced to a simple formula. The whole system seems so complete and satisfactory that there is no need for any further search for a system of colour nomenclature.

The reason for the differences which exist between scientists and artists as to which are primary colours is due to the fact that scientists generally use the spectroscopic or additive method, and artists the subtractive or absorbtive method.

A general rule in lighting a stage is to use at least two colours. A stage lit with mono-chromatic light tends to be dull and flat. Thus it is desirable in all cases to use a different colour at front and back, or at each side. A producer with imagination will be able to apply the principles given above to advantage, but the following examples may be of assistance.

These effects were used in a London music hall for a

dancing turn. The whole stage was flooded with red light and an intense white light was directed on to the performers from the front of the house. The shadows remained a deep red, while the high lights were white. A similar effect was produced by using blue light from one side of the stage and yellow from the other. Where these colours mixed they produced white, which again was the colour of the high lights. Beautiful shadows of yellow and blue formed in the draperies and the folds of garments.

Chapter VII

DESIGN OF THE THEATRE

It is not often that a company is able to build its own theatre, however "Little," but occasionally it is able to build its stage in an existing hall to its own idea.

Where there is no intention to throw open the doors to the general public, the design is a fairly easy matter, in other cases it must be brought into accordance with the views of the Licencing Authority. Where this Authority happens to be the London County Council the obstacles thrown in the way of any reasonable design are almost insurmountable. Unfortunately the L.C.C. regulations are passed for large commercial theatres, and insufficient allowance is made for small halls seating only two or three hundred people. In the London district it will probably be found necessary either to abandon the scheme altogether or the idea of admitting the general public on payment at the door, and so avoid the necessity for a license.

The following are the conditions desirable for a Little Theatre:—

The Stage.

The stage floor should not be raised higher than is necessary for visibility. If the seating has to be on a level it will be necessary to have a higher stage floor than in the case of a sloped auditorium. The discomfort and the false perspective experienced by persons obliged to look up at the knees of actors on an unnecessarily high stage are not adequately compensated

for by the slightly better view obtainable from the back seats. The stage itself should be flat. A raked stage is obsolete and causes endless trouble with scenery.

Some authorities consider that the depth of the stage should be equal to the width of the proscenium opening, but it is desirable to have a wide shallow stage rather

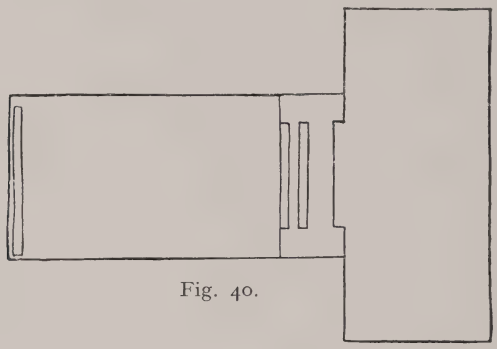


Fig. 40.

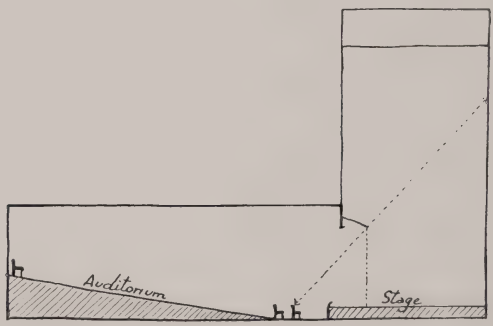


Fig. 41.

than a narrow deep one, as on the latter the actors must to some extent mask each other. There should be room at each side, above, and behind, and if possible the space under the stage should be utilised for properties which can be lowered through a trap-door. The trap will be useful for other purposes. It will be seen from the above that the shape of the stage and auditorium (neglecting any other part of the building) will be in plan something like Fig. 40, and in section like Fig. 41.

It is too much to hope that all these conditions will be fulfilled. The first that may be dispensed with is the space at the back, as a plain white-washed wall may be used in conjunction with coloured light instead of a back cloth. One of the other conditions *must* be present, however, and I would prefer that it be the one of overhead space, as then scenery can be easily changed by being hauled up out of sight (technically *flied*). The total height should therefore be a little more than twice the height of the proscenium opening, but if it can only be one and a half times that height, cloths and curtains can be *tumbled*, i.e. raised by top and bottom together so as to be folded in half.

In cases where borders are to be dispensed with and any form of dome or cyclorama used in conjunction with flied scenery, it is absolutely essential that the flied scenery be raised sufficiently high to clear the line of sight from the front row of the stalls. (See Figs. 43a and 48.) Very few architects or stage designers in England realise this point, and several theatres have been built in London recently equipped with complete Schwabe lighting and Hasait cycloramas before the discovery has been made that the grid is not sufficiently high to allow the equipment to be used to full advantage; thus the scenery hangs so low that borders have to be used to mask it from the audience, and the shadows of the scenery and borders are thrown on to the cyclorama by the Schwabe lamps situated over the proscenium. Or alternatively, the whole of the flied scenery has to be dispensed with in any play in which the cyclorama is to be used. This alternative is generally impossible in London as, owing to the high price of the land on which the theatres are built, it is not possible to afford room for the scenery elsewhere, for instance at the sides.

A door leading to a storage room or yard is a good substitute for side or back space, as scenery such as flats can be carried out of the way.

Conversions of Existing Buildings.

Private Houses—Studios. The rooms must be at least twelve feet high. The usual practice is to remove the folding doors between two large rooms and substitute tableaux curtains. In old-fashioned houses suited to this arrangement about sixty people can be seated comfortably. The plays which can be performed are naturally limited in number and open-air scenes must be avoided or merely suggested. There will not be sufficient head-room to allow of a raised stage, and it is better to divide the acting-area from the auditorium floor by means of a simple partition about a foot high, behind which footlights may be concealed. This has the advantage that existing fire-places and doors may be used when desired. Borders should not be used, the lighting being confined to footlights (a very few), good side lights, and a good batten behind the proscenium valence. A flood on each side at the back of the stage will complete the equipment, but it may occasionally be supplemented by small spots, or focus lamps, used from the back wall of the auditorium.

Fit-ups. This term is used to denote temporary stages and prosceniums. Companies which perform in hired halls frequently use *fit-ups*, and even where there is plenty of head-room it can rarely be used for the purpose of flied scenery, as the proscenium probably does not reach to the roof of the hall, and so cannot conceal the stage mechanism above it. In these halls the use of borders and battens is, unfortunately, necessary.

Permanent Conversions. Small premises which are always at the disposal of a company are more valuable than more elaborate theatres hired for a few performances. No experiments in lighting or *décor* can be carried out on hired premises. When converting any buildings for the purposes of a theatre, the first aim should be to have a stage where borders are not required. This can only be done by having plenty of head-room.

Fig. 42 represents an arrangement, the principal features of which are:—

(i) A white-plastered back wall.
(ii) Removal of ceiling over stage.
(iii) Scene store and workshop over the auditorium.
(iv) Absence of borders, and back-lighting by floods placed on the floor above, and in a trough at the back of the stage.

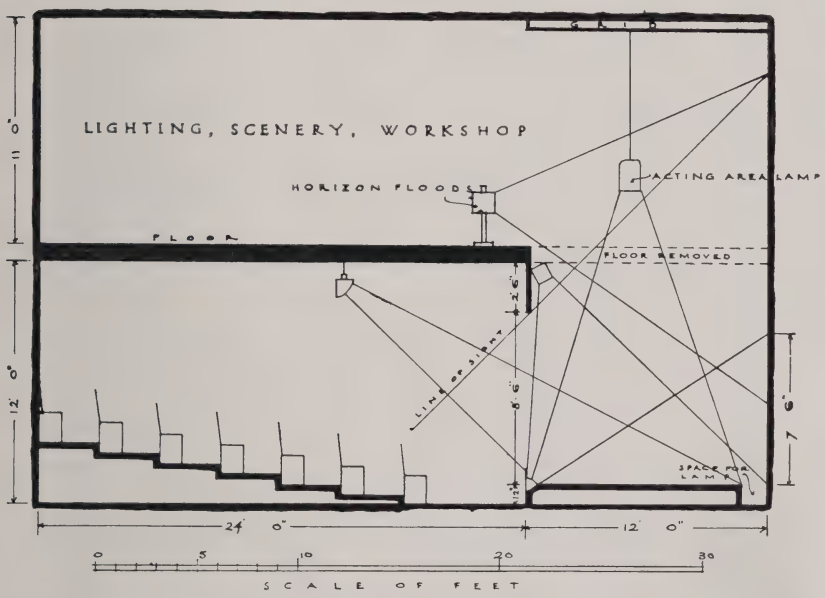


Fig. 42.

Flats used in box-scenes may be hoisted up and stored above the auditorium, and furniture and properties lowered into a cellar. Once this system is adopted, open-air scenes present little difficulty or expense, all that is essential is to mask the sides of the stage and use a low ground-row to hide the trough of lights at the back and aid the idea of distance. For larger stages the plaster wall at the back can be curved round at the sides and allow further economy in scenery. The acting-area lights consist of foots, side-lights, and one batten. They

can be supplemented by small lamps in the auditorium. Box-scenes will need to be fitted with ceilings.

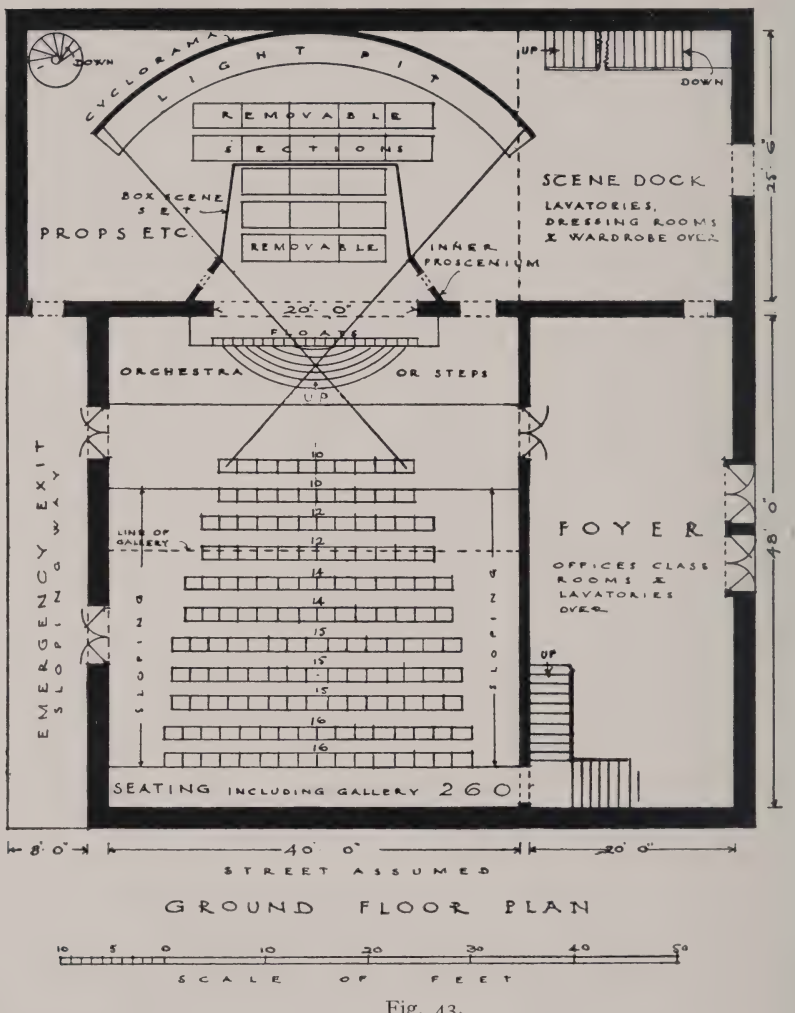


Fig. 43.

New Buildings. The cost of a new theatre on up-to-date lines is so great that many compromises are inevitable. Fig. 43 is a suggestion for such a building.

Where space allows, the balcony may be dispensed with and the seating carried back in a parabolic curve instead of a straight slope. Such a theatre will have to earn its keep by being hired out frequently, and the provision of a rehearsal room overhead, for use when the stage is let, is an important feature.

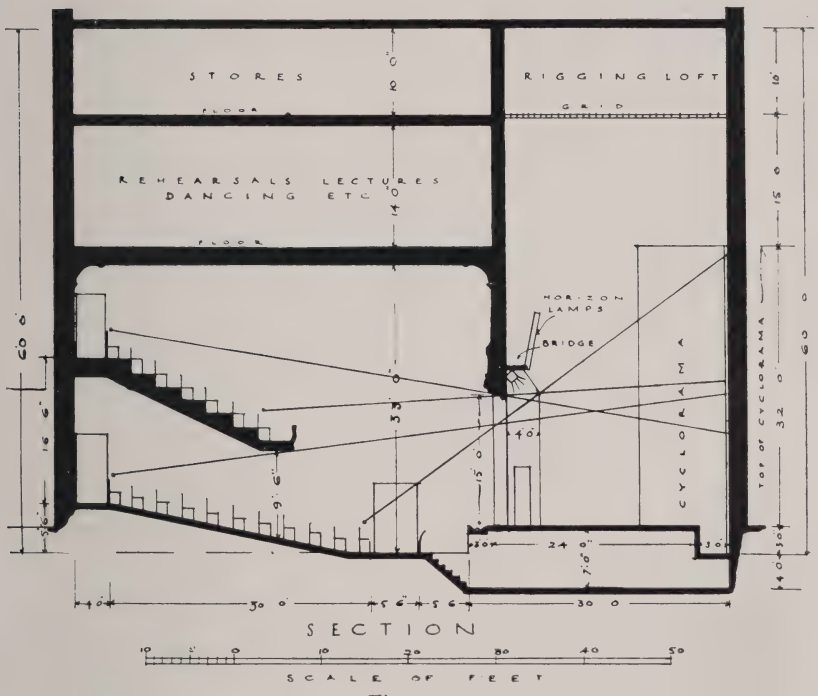


Fig. 43a.

Auditorium Arrangements—Lines of Sight.

In a small auditorium it is better to arrange gangways at the sides so as to leave the best seats in the centre.

The seating should be arranged so that everyone can see the whole of the acting-area. This means that the proscenium opening should be nearly as wide as the auditorium.

It is a mistake to expect an audience to enjoy itself for three hours in uncomfortable seats, and if tip-up chairs cannot be provided, at least sufficient room can be given. Rows should be placed 36 inches apart from back to back of chairs, which should be of the low-backed variety to give extra room for passing between rows. Each seat should be allowed a width of 20–24 inches.

When the seats are *raked* each row should be at least six inches higher than the row in front, and this allowance must be increased in balconies. The higher the balcony the steeper the rake. In small theatres the rake may be an incline, but in large ones it should take the form of a parabolic curve.

The highest seat should not be above the level of the proscenium arch. This rule is often altered by pressure of circumstances into allowing the highest seat to be so placed that a line drawn from eye level and passing under the proscenium top, strikes the back cloth 7 feet above the stage floor. A line drawn from the eye-level of a person in the back row of the lowest seats (Pit) to the top of the proscenium opening should give the limit for the downward and forward projection of a balcony.

The proscenium opening may well have a height of three quarters its width. This low rectangular proscenium opening is the best from a practical point of view, and is considered by many to be pleasing architecturally. The proscenium should entirely cut off the stage from the auditorium; the fit-up proscenium, which does not extend to the ceiling (the Punch and Judy variety), destroys all stage illusion.

A line drawn from a back corner of the acting-area past the edge of the proscenium opening on the same side will give the position and limit of the side seats; or if the seats are already in position a line from the side seats past the edge of the proscenium opening will give the limit of the acting-area, and the position of the side scenery. This study of sight lines is usually

neglected, sometimes even in London theatres, where actors may be seen by those in side seats awaiting their cue in the wings.

In the National Theatre competition, organised four years ago by the British Drama League, most of the competitors seemed ignorant of the most elementary requirements of a theatre. It would seem that only one or two had studied the recent developments of theatre construction before drawing their plans. One design had an auditorium which approximated to a circle combined with the ordinary picture-frame proscenium.

In cases where the use of borders cannot be avoided it is necessary to take lines of sight from the eye level of the front row to determine the relative position of the top of the back-cloth, battens, borders, etc. It is possible to use very few borders, in which case they must be deep, and hence take away from the stage height, or to use many shallow ones, but in the latter case the distribution of lights will be increased as every border must have a row of lights behind it in order that its shadow may not fall on the one behind it, or on the back-cloth. A series of alternate dark and light borders is unthinkable, and only calls attention to a part of the stage where it is least desired. In any case borders are a horrible device, resembling washing hung out to dry.

The obvious course is to use a moderate number of borders of moderate depth, each with its own lights. It is seldom wise to put the borders closer to each other than 4 feet, and for the stage shown in Fig. 37 the first border is 4 feet from the proscenium, the second 5 feet from the first, and the third 6 feet from the second. The height of the borders above the stage depends on what head-room is available and what height of back-cloth is possible. Generally the height from the stage to the bottom of the borders is equal to the height of the proscenium opening. The depth of the borders in the case cited would be about $2\frac{1}{2}$ feet.

The top of the proscenium may be treated as a border,

and No. 1 batten is placed immediately behind it, there being another batten behind each of the remaining borders. In the case of the last border (No. 3 in this case) the batten may with advantage be placed immediately over the back-cloth.

Proscenium Draperies. The size of the proscenium opening may conveniently be reduced for certain scenes by having a valence at the top capable of being lowered several feet and curtains which open in the centre and draw horizontally. These curtains by not being fully drawn apart reduce the width of the opening very easily, and if they draw on separate cords it is possible to use the centre of stage, one side of stage, or the other side only.

Prosceniums and Acoustics. It will be noticed in Fig. 43 that there is a very definite proscenium opening to the stage. Since my experience at the Festival Theatre, Cambridge, I would prefer to modify this opening to a less pronounced form by having splayed walls, reaching from the side of the proscenium to the exit doors near the orchestra. If these splayed walls are fitted with doorways which can be used as entrances to a temporary fore-stage, so much the better. The splayed walls and flat ceiling are the best simple architectural form acoustically, and have the additional advantage of providing extra stage space for a switchboard on one side with a view of the stage, and a convenient stage manager's corner on the other side. It is not within the scope of this book to go into the technical details of acoustics, but the subject has received considerable attention lately, and is at last being placed upon a scientific basis. A good deal of research work has been done in America, with special reference to the design of kinemas, which now have to be built both for seeing and for hearing. A reference to the "Ideal Kinema Supplement" of November, 1927, would be useful in this connection.

I believe the ideal repertory theatre to be an impossibility, because in any repertory programme plays of all

ages and of all countries must be produced, and as the various playwrights have in many cases written their plays to conform to the technique of their own day, they will each need a particular type of theatre for the performance of their plays. Many special theatres have been built, such as Reinhardt's Grosses Schauspielhaus, Berlin, and the Festival Theatre, Cambridge, England, which have been highly successful for plays adapted to their peculiar architecture. However, as soon as the supply of such plays runs short, theatres of this kind can no longer be used to their best advantage.

Compromises are always unsatisfactory, yet unless the repertory company can afford to control several theatres of different architectural design, they must either make such compromises or else limit their choice of plays. The definite picture-frame proscenium with the appalling over-ornamentation to which we are accustomed in the West End of London need not be considered, but I feel that the proscenium *idea* is one which has evolved steadily and still represents the highest advance. The retreat of the actor behind the proscenium is, generally speaking, desirable. Whatever we may do in the theatre, some conventions must always exist in the minds of the audience, and the mixing of actors and spectators is a very dangerous experiment (often a mere "stunt effect"), unless the author has deliberately written the play for such treatment.

Certain simple plays demand absolute realism, but with these few exceptions realistic production is definitely a thing of the past and is unlikely to return, and although one still wishes to create illusion in the theatre, it is the *illusion of atmosphere* and not of reality. It is only for a few moments, and at rare intervals, that the individuals in the audience are so carried away that they can forget that they are sitting, together with other people, in the auditorium of a theatre. They must, at most times, be fully conscious of the presence of their neighbours, and we have at once a convention which it is quite impossible to disregard. Moreover, in nearly

all plays there must be a definite line at which the illusion stops and reality begins, and this might just as well be the proscenium as anywhere else. With an unobtrusive proscenium a Greek play can be adequately performed with, let us say, a flight of steps in place of the modern orchestra, and the abolition of the tableaux curtains, thus securing the necessary intimacy between stage and auditorium. The continuous performance of a Shakespeare play is equally possible, by substituting a flat fore-stage for the steps, and using the side portals with the tableaux curtains, and possibly additional curtains (Elizabethan traverses) half-way up stage. For modern drawing room comedies, crook plays and the like, the fore-stage can be entirely dismantled, and the play performed in the ordinary fourth-wall convention, the proscenium being emphasised as much as may be desired. From the point of view of the stage technician the complete absence of some sort of proscenium makes his task more difficult, and sometimes nearly impossible, because an auditorium and stage that merge into one another deprive him of the very important side lighting, and renders the task of the switch-board operator, stage manager, and prompter, incalculably more difficult.

Note by Mr. Terence Gray.

"Mr. Ridge, well knowing that I would be in considerable disagreement with much of this chapter, has most generously asked me to set down my own views on his contentions.

Accordingly I will take four of his statements in turn. In the first place he maintains that the ideal repertory theatre is an impossibility, because of the various types of plays that have to be produced in it each requires performance in the technique (in this case the architectural medium) the author had in mind while writing it. But is this so? Need Shakespeare be performed in the Elizabethan manner? Is he so produced to the best advantage in the present day, with three centuries of

development, of experiment, of mechanical invention intervening? Cannot Max Reinhardt, Jessner or Hilar make more of Shakespeare, producing him with all the forces of modern continental stagecraft at their command, than can some archaeologist reviving the conditions of the Elizabethan stage? True, I would rather see Hamlet done by Nugent Monck at the Maddermarket than by any *trade theatre* producer in a West End playhouse, but I would rather see it done by Jessner in a Gothic Cathedral than by Monck in his reconstruction of an Elizabethan theatre.

Where modern plays are concerned many authors are quite unqualified to judge of the technical media best suited for the performance of their work. The fact that the general ideas of stagecraft in their minds are based on such knowledge as they may have been able to acquire of conditions obtaining in the traditional theatres of their day does not necessarily mean that those theatres are the most suitable architectural media for the production of their plays.

This leads on to the second contention which I dispute, that special theatres, such as those quoted, are only suitable for certain types of plays. My own experience has led me to the belief that every kind of play of which I have had personal experience has greater force, comes over more inexorably, holds the audience more securely and more comfortably when it is performed in direct contact with the audience—i.e. in the same architectural unit in which they are seated—than when cut off from them by the four-sided intervention of a proscenium, whose tentative intrusion facilitates the breaking of contact and slackening of attention. From this I must exclude detective and ultra-realistic melodrama, which are perhaps the only types I have never seen treated on an open stage. So far from realism and exact naturalism requiring the picture stage theatre, I would maintain that these above all types benefit by being performed in immediate contact with the audience.

The third contention I would dispute is that in nearly

all plays there must be a very definite line at which illusion stops and reality begins, and that this might just as well be the proscenium as anything else. I would say rather that the aim should always be to keep this line of demarcation as indefinite as possible, so that only by deliberate searching can it be traced out. Needless to say I am in full agreement with Mr. Ridge's admirable remarks on the substitution of the Illusion of Atmosphere for the Illusion of Reality.

The final point is Mr. Ridge's contention that the stage technician, lacking a proscenium, is incommoded and deprived of important side and (he surely should have said) foot lighting. This surely is a question of architecture. In turning an old picture-stage into an open stage, this is likely to occur, but in a new building I contend that not less but far greater facilities and scope can be given the stage technician than he ever had within the limit of his proscenium." T. S. G.

Cycloramas.

The various methods of construction so far experimented will fall naturally into two divisions—permanent and temporary. The permanent type are usually in the form of a semi-cylinder, or dome, of plaster on a metal framework. The general disadvantage is the encumbering of the stage during scene-shifting or when the cyclorama is not required. The advantages are low cost of upkeep and an excellent smooth surface, free from wrinkles and not affected by draughts or accidental disturbances.

In the Charlottenburg Opera House, Berlin, where no expense has been spared, a colossal plaster dome is housed at the back of the stage with a lighting bridge at the upper edge of the dome, (but moving separately if required). The dome can be used in this position or moved forward bodily by electric motors to enclose completely a scene previously set in front of it on the main acting-area—or the scene may be slid on from either side to replace a used set (similar to the Dresden

Schauspielhaus arrangement on stage level, instead of in the basement). The dome is hung from girders running up and down stage above fly-gallery height, and when in its back position it allows flied scenery to be used in the usual way.

It will generally be found that a portion only of the permanent cyclorama is the best practical solution of the whole problem. (See Figs. 43, 44, 45, 47, and 48.) Now-a-days a hard cement is used instead of plaster, which is very easily dented, and then fails to give that sense of infinite distance which is the most wonderful property cycloramas possess. The surface can also be painted (white or in colour) with a washable paint which is easier to keep clean than distemper or ordinary priming. Although the modern tendency is to use cylindrical cycloramas, there are occasions in small theatres where a curved top, or dome, may be useful. Less vertical height is required, and in cases where flied scenery is not to be used, this pattern is the best to employ.

With the dome type, perfectly even flooding takes place with the lights either over the proscenium or near the top edge of the dome, but with the cylindrical type the lights must be kept well down stage, or the cyclorama will show bright patches opposite the lamps. The lights used round the bottom of a cylindrical cyclorama at, or below, stage level only affect it noticeably near the bottom, but with a dome the curved top is affected strongly unless special precautions are taken to mask the lights from it; in fact it is possible with a dome to light almost entirely from the ground, though the centre portion may require help from the battery of lamps in front.

The reasons for all this are not far to seek, the more glancing the angle of incidence of the light on to the cyclorama, the more glancing the angle of reflection, and the more likely is the light to be reflected away from the audience.

Of the temporary type the most famous is the double silk dome invented by Fortuny and still used at La

Scala, Milan. (They also have two larger ones of a different type.) This dome works like the hood of a perambulator, the metal rims being kept in a vertical position until required, when they open out into the shape of a quarter orange with the bottom rib near the stage floor. The silk is kept tight and free of wrinkles by being made double with a space of a foot or so between, and this space is exhausted of air by a power-driven exhaust pump. The effect of this cyclorama is magnificent, but its prime cost and maintenance put it outside the range of ordinary stagecraft.

The latest type of temporary cyclorama consists of a semicircular cloth *so suspended* as to be kept in tension and free of wrinkles. It can be rolled on a vertical roller at either side of the proscenium when not required in about thirty seconds. The system of suspension prevents movement by ordinary draught, but it is not proof against severe ones or the activities of scene-shifters.

The best example of this type of cyclorama is the Hasait cloth, used extensively in Germany and in a few London theatres very occasionally.

In a theatre already built and not lending itself to alteration, this is probably the best type of apparatus to instal, but it must be remembered that no grids are high enough in England to allow scenery to be flied above the top of the cyclorama, which is itself 50 or 60 feet high.

Examples of Modern Theatres.

Before closing this Chapter, I propose to give a brief account of two theatres in this country which have been built or used according to the general principles laid down in this book, and to conclude with a short description of one of the most perfectly designed theatres in the world.

The Festival Theatre, Cambridge.

The Festival Theatre was founded by Mr. Terence Gray and myself, with Mr. Herbert M. Prentice as its

first producer and Mr. Norman Marshall as stage-director, in the hope that it might become a centre for the practice of advanced stage-craft and experiment; a sort of University of Dramatic Art, to which students might graduate from the elocution, art and literary schools, a centre (not run for profit), at which annual dramatic festivals might be held—with visiting companies from all the repertory theatres in the country.

The Theatre itself is said to be the oldest surviving theatre in the British Isles. It was for many years called The Theatre Royal and was visited by most of the distinguished actors of the Victorian era, among them Macready, Charles Kean and Sheridan Knowles. It existed in 1745, was rebuilt in 1816, but became the home of a mission in 1878. The general features of the auditorium have been retained, but it has been strengthened, redecorated, refloored and reseated, apart from the building of lavatories, lounges and additional exits. The stage has been almost entirely rebuilt, and a cyclorama of a total height of 40 feet has been erected at the back of the stage. This is constructed of a double thickness of hollow tiles covered on the front with sirapite and finished with Keen's cement. The advantages of this method are that the hollow tiles are excellent acoustically and the very hard parian prevents accidental denting, should pieces of scenery be run against it. The surface is finished in white distemper, but a washable paint would probably be better. The level stage comes out into the auditorium and merges into it down a flight of broad steps, which stretch the full width of the building. A reference to the plan and section in Figs. 44 and 45 will make the construction clear. The roof and lighting bridge are all built in reinforced concrete by the Monnoyer British Construction Co., Ltd. The lighting bridge serves two purposes: it accommodates the Schwabe lamps for lighting the cyclorama and cuts off the line of sight from the front row of the stalls, and so limits the cyclorama to a reasonable height. As a box scene can be set under this lighting bridge, the

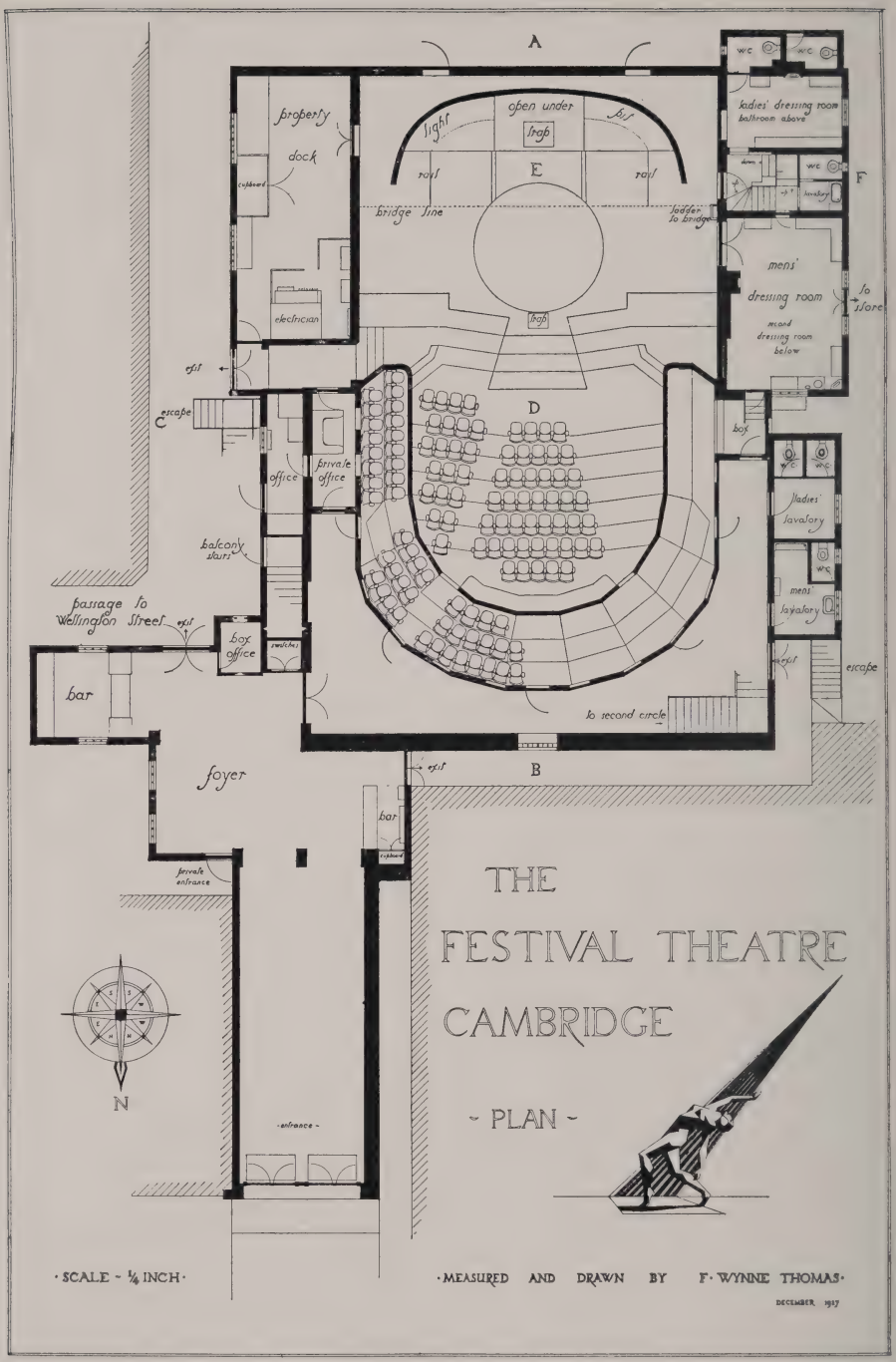
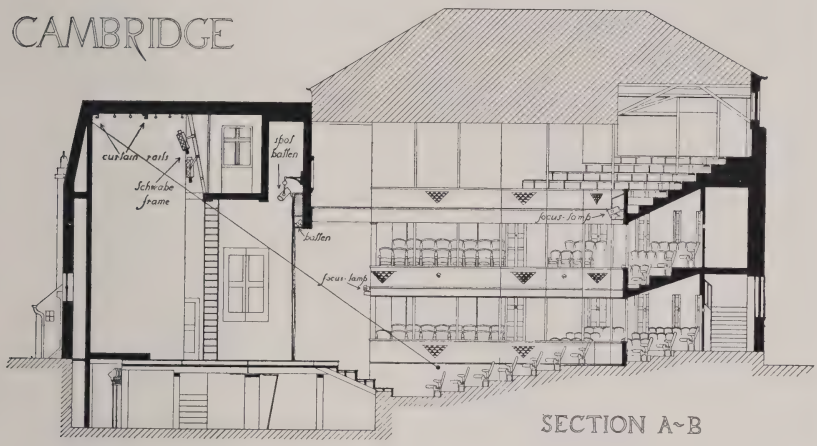
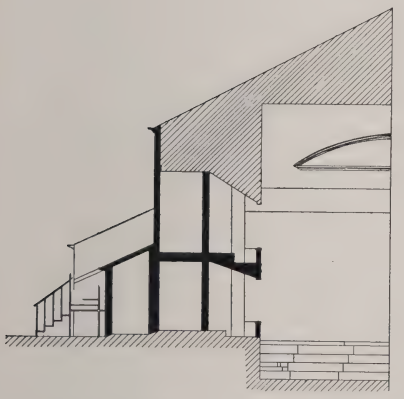

A
B
C
D
E
F
W.C.
ladies' dressing room
bathroom above
property
dock
cupboard
electrician
open under
stage
light
rail
bridge line
ladder to bridge
men's
dressing room
second dressing room below
to store
exit
escape
office
private office
box
ladies' lavatory
men's lavatory
balcony stairs
passage to Wellington Street
box office
switches
bar
foyer
to second circle
private entrance
entrance
THE
FESTIVAL THEATRE
CAMBRIDGE
- PLAN -
N
SCALE - 1/8 INCH
MEASURED AND DRAWN BY F. WYNNE THOMAS
DECEMBER, 1937

Fig. 44.

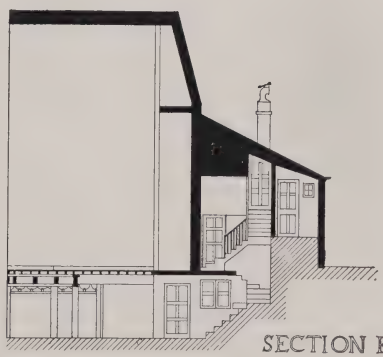
THE FESTIVAL THEATRE CAMBRIDGE



SECTION A~B



SECTION C~D



SECTION E~F

SCALE - ¼ INCH.

MEASURED AND DRAWN BY F. WYNNE THOMAS.

Fig. 45.

ordinary ceiling pieces are not required. There is no grid in the ordinary sense of the word; and although scenery can be flied with the use of borders, this practice is not followed for reasons that have already been mentioned. To enable scenery to be flied without interfering with the cyclorama or Schwabe lamps, it would have been necessary to raise the roof another 20 feet, and the cost of this and the necessary rigging would have been too great, apart from the fact that the old foundations would not have stood the weight.

The back portion of the stage inside the curve of the cyclorama is raised 8 inches above the remainder and rolls forward in three sections, if necessary as far down stage as the back of the lighting bridge, so that the whole of the stage under the centre portion is open, allowing properties to be lowered into the cellar, and actors to make their entrances from there. In outdoor scenes this movable platform is pulled forward three feet only and exposes the battery of lights used for illuminating the lower portion of the cyclorama, as mentioned on page 84. The usual type of counter-weighted trap can be used in the centre portion of this sliding stage when desired. A 15-foot turntable occupies the centre of the acting-area, turned from below by hand gearing. The portion under the fore stage steps is occasionally used for an orchestra, although the theatre has not been designed for opera or musical plays. The examination of some of the settings illustrated in Chapter VIII will show the advantages of this type of theatre, but against these advantages are the facts that there is practically no wing space and the changing of scenery and storage behind the cyclorama is a difficult and sometimes lengthy proceeding. The necessity also of placing the switch board off the stage, and even in a separate room, handicaps the electrician considerably, although, with a little practice, control by signal is not so difficult as it would seem. The absence of greater width (in the places now occupied by the switch room and dressing rooms) or alternatively of a proscenium, make the rapid

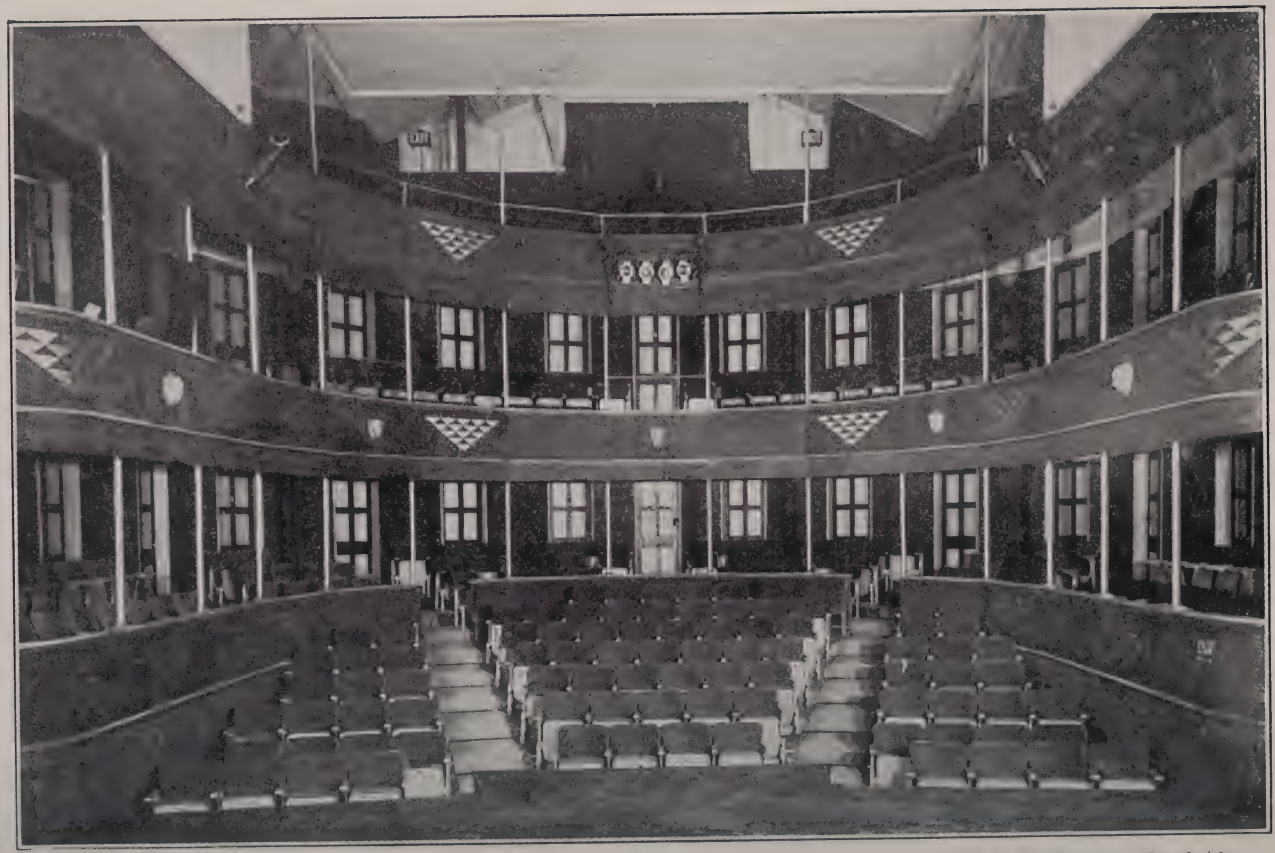
disposal of furniture and such properties a difficult problem; and the fact that the fore-stage steps are a permanent feature, and therefore an integral part of the scene, preventing the use of footlights, is not always a convenience, and it might be better in future to design a stage with the usual front and disappearing float, adding the steps when needed.

The scenery and properties of only one production are kept on and about the stage, the main store and workshops being in a separate building. During a change of production, doors on both sides of the dressing room shown on the left of the stage are opened and the scenery run through into the store beyond and the new production, which has been previously prepared, brought in.

The auditorium as seen from the stage is shown in Fig. 46.

The switch board has already been illustrated in Fig. 23. The lights group themselves naturally under four heads; the front-of-the-house lighting, which consists of six 1000 watt focus-lamps, is used primarily for the fore-stage and also in place of floats. Four of these lamps are situated on the front of the gallery and one at each side of the auditorium on the return of the dress-circle. As the building is an old theatre which has been modernised, it was found impossible to fit colour magazines on these lamps, but by the judicious selection of mediums it is not necessary to change them during performances.

The acting-area can be flooded from the batten, which is actually fixed in front of the tableaux curtains. This has the advantage that it can be used to assist the lighting of the steps when the tableaux curtains are closed, and improves the appearance of the curtains during intervals. The disadvantage of placing the batten here is that it is inaccessible to the electrician during the performance. Immediately behind the tableaux curtains is the spot-batten, holding five 1000 watt focus-lamps and two 500 watt. The portable



Festival Theatre, Cambridge, 1926. Fig. 46. *Scott & Wilkinson, Cambridge.*

stage equipment consists of two 1000 watt focus-lamps, two 500 watt and two baby spots, in addition to six 500 watt flood lamps. These portable lamps are served from six stage dips. The cyclorama lighting consists of a battery of twenty 1000 watt Schwabe lamps in the following colours:—

Dark Blue	6
Middle Blue	4
Light Blue	2
Daylight Blue	2
Green	2
Yellow	2
Red	2
	20

These lights are worked in conjunction with the lights in the pit round the bottom of the cyclorama already described in Chapter VI. Roughly speaking, there is a dimmer in each circuit as follows:—

One for each front-of-the-house circuit.
One for each of the three circuits in the batten.
One for each lamp in the spot-batten.
One for each of the six stage "dips."
One for each *pair* of Schwabe lamps.
One for each of the three pit circuits mentioned above.

In addition there are three dimmers controlling the decorative lighting in the front-of-the-house.
Royal College of Music, London.

For the plan and section of the theatre shown in Fig. 47 I am indebted to the producer, Mr. H. Procter-Gregg, and Mr. Michael H. Wilson.

There is a certain air of romance about this theatre, and I feel myself that the whole thing is a most satisfying achievement. I would even go so far as to say that, neglecting the matter of size, this is the best equipped building in London in which to practise the art of the

theatre. The following description of the theatre was written by Mr. Procter-Gregg and is so delightful that I have quoted it in full.

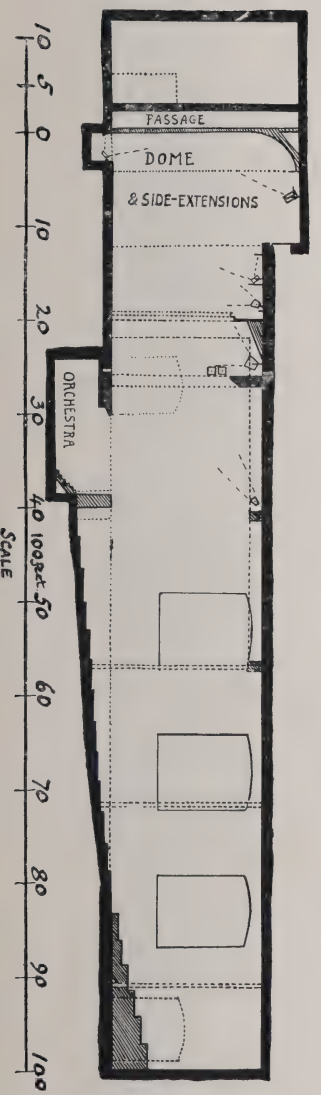
"The Parry Opera-Theatre is a converted basement, the Director of the College, Sir Hugh Allen, having encouraged ingenuity and resource to take all the advantage that could be wrung from its considerable restrictions. The main culvert of Kensington was diverted to make a sunken orchestra; the girders supporting the concert hall above were propped and dodged to give working room to the stage; a plaster 'heaven' and lighting-trench supply 'distance' where, in fact, an organ-blowing apparatus limits anything of the kind; a permanent false proscenium pretends with some success that heaven is more than 15 feet high.

"The acoustics have been carefully and beneficially doctored, and the balance of voices and orchestra is generally good.

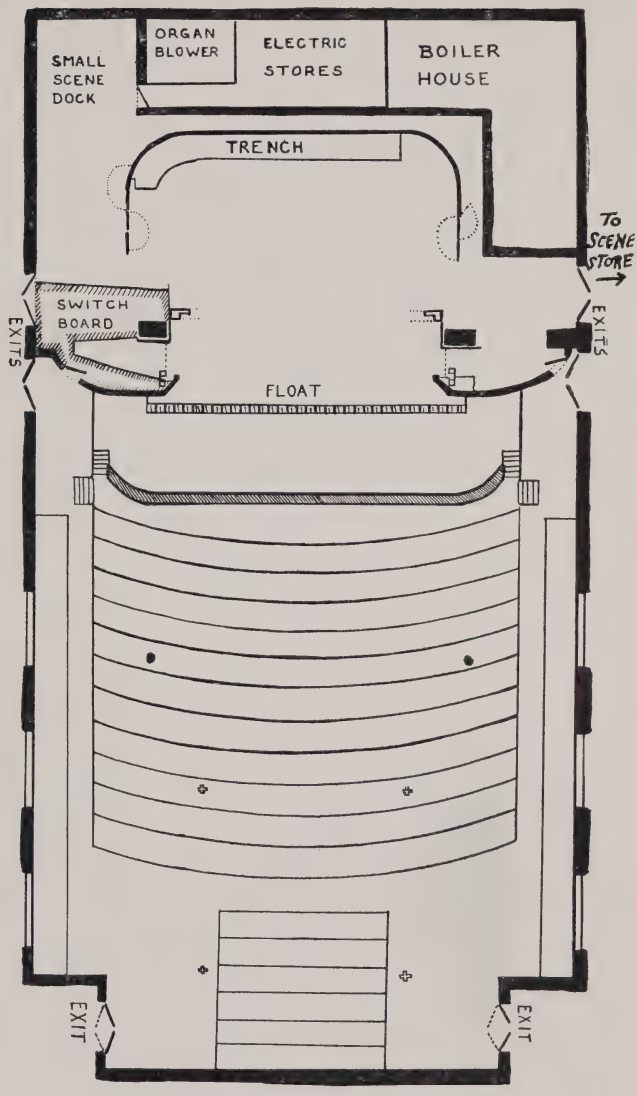
"The raked auditorium was obtained by quarrying out the foundations and knocking up some box-rostrums. By building and conversion large dressing-rooms are available fully equipped. In addition to the scene docks shown, a scene-store has been put up adjacent to the stage (both on ground-floor level); if no 'stuff' can be 'flied,' much can be 'run on and off.' A passage behind the heaven makes up for no under-stage transit. Girders and their props have been an inevitable relic of the theatre's past; its false proscenium, plain columnar style of stage architecture and the severe square panelling of the auditorium have reduced these girders to a minimum of obstruction and a certain unity of decorative effect. The stage-lighting is described elsewhere.

"In short, by a patient adaptation of unlikely means to imaginative ends (which is the pith of stagecraft), an opera-theatre has been evolved where nearly 600 people can see a properly-mounted grand opera with an ensemble of 60 or more, and hear (without seeing) an orchestra of 50. (There were 60 on the stage in 'Hugh the Drover' and 13 scenes in 'Pelleas et Melisande.')"

The switch board at this theatre was invented and designed by Mr. Michael H. Wilson, and the work was excellently carried out by the Strand Electric Co. The switch board, which is shown shaded in the plan, is situated above stage level, leaving the space beneath



Parry Opera Theatre.



Royal College of Music, London, 1928.

Fig. 47.
Plan and Section.

quite free, with a very excellent position near the proscenium for the stage-manager. The electrician also has an excellent view of the stage from the light perches on both sides of the proscenium. He can also see the cyclorama from the back of the switch board platform and, in most scenes, the acting-area also.

The new system of lighting used in this theatre is the outcome of its growing needs, the key-note of the whole system being flexibility. Any type of lamp may be used in any position on the stage and controlled either independently or in conjunction with any number of other lamps and by means of any suitable dimmer. The dimmers may, in their turn, be connected to form groups for purposes of black-outs and quick changes, and any dimmer may be plugged into any circuit as required. The general arrangement of the switch board, in fact, is on the lines of a telephone exchange, and by the system of supply it is possible to set the lighting for a fresh scene during the progress of the previous one, so that very quick changes are possible. In the case of opera this is very necessary, as there may be as many as twenty scenes which follow one another in rapid succession, the intervals being dictated by the music. The stage has thus no set scheme of lights, but every production can have that type of treatment best suited to it. There are 120 stage circuits, 32 switch and dimmer circuits, and 3 main circuits with remote control switches. The operation of the controls is apt to be extravagant in respect of brain work, but is certainly economical where manual labour is concerned. The possibilities of the system are being explored. The stage wiring terminates in almost every case in a fixed plug socket both on floor and ceiling. Thus spots, floods, lengths, etc., may be quickly connected or interchanged. The only exception is the float, which is permanently connected to the switch board in fifteen circuits (i.e. three sections of five colours each). No lacquered lamps are used, but gelatine mediums throughout, The horizon floods are mostly of the home-made variety,

similar to the one illustrated in Fig. 38, but of much larger size. This is necessary with gelatine mediums, on account of the heat, and no doubt, if the theatre was in use all the year round, the expense of renewing the gelatines would lead to the use of the Schwabe type of apparatus.

Front-of-the-house spots and floods are regularly used, being situated over the orchestra rail, as can be seen in the section.

Broadly speaking, the usual arrangement of sources of light is as follows:—

Horizon lamps (20 circuits),
Ground lengths sunk in trench (10 circuits).
No. 3 batten (independent units) 7 plug points.
No. 2 batten, independent units—about 8 lamps.
No. 1 batten, independent units—15 units, large lamps.
Proscenium lamps (perches) 5 plugs each side (usually 2 or 3 lamps).
Stage dips. 9 plugs each side.
Float. 15 circuits, also 3 plug points for effects.
F.O.H. 5 plug points, usually 3 lamps.
Arcs are used for special effects only.

The operation of the dimmers in this theatre is unique. They are of both liquid and metallic types, operated by tracker wires. The tracker wires are operated hydraulically and will move smoothly at any required speed. By setting the hydraulic valves in any predetermined position, dimming or colour changes can be carried out at any speed, lasting even for half an hour, leaving the electrician free to attend to other duties in the interval. This does away with the necessity for mechanical interlocking, and differential dimming is possible without any extra apparatus or expense. Should it be necessary to operate all the dimmers together, the master hydraulic valve can be used for this purpose.

This system has such obvious advantages that I consider it has a great future in the theatre. The work

done at this theatre is at an immensely high level, and in Chapter VIII there is a short account and an illustration of one of the scenes from a recent production of "Pelleas et Melisande."

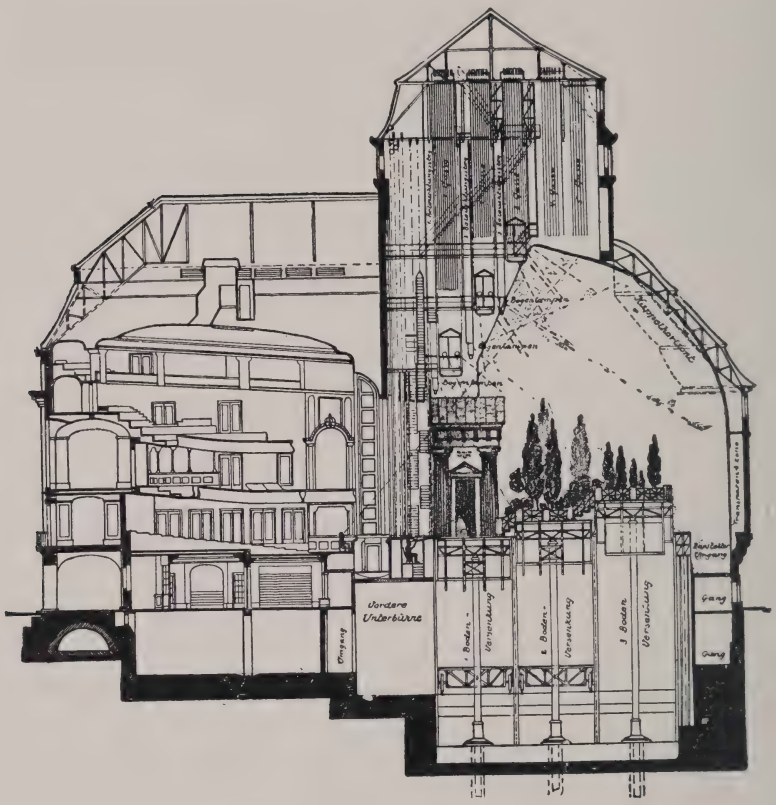


Fig. 48.

The Sliding and Sinking Stage. A section through the Königliches Schauspielhaus showing the three lengthwise divisions of the stage raised to different levels to represent terraces.

The colour treatment of the cyclorama is important. Theoretically, white is the best colour; but Mr. Procter-Gregg, after his experience on the continent, decided to tint the upper part a bluish-green, fading into deep cream at the bottom. This makes no appreciable

difference with the dark colours, and much improves the effect with light colours or white light.

The Schauspielhaus, Dresden.

This theatre was built about 1916, being called at that time the Konigliches Schauspielhaus, under the technical directorship of Adolph Linnebach. This theatre affords

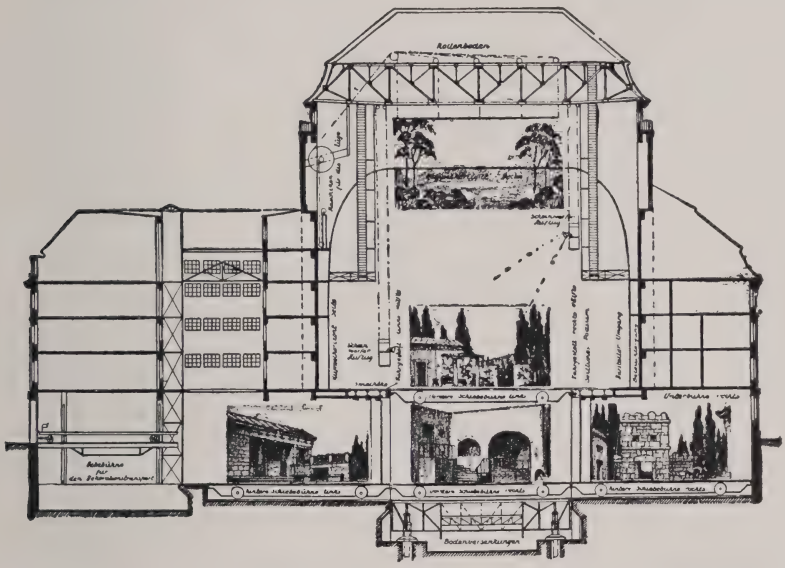


Fig. 49.

The Sliding and Sinking Stage. A section through the former Königliches Schauspielhaus in Dresden. The drawing shows at the top a backdrop suspended from the gridiron in the ordinary fashion. In the basement are three other settings waiting for the stage to be lowered, the used scene slid off, and one of the three moved into its place, and raised to the stage level, occupied in the drawing by an exterior setting. The front edge of the dome is indicated by the curving line.

a splendid example of the sliding-and-sinking stage, as shown in the section in Fig. 48.[1] The stage is divided into three sections, working on hydraulic rams. This enables the stage to be raised or lowered to different levels to represent terraces and the like. It can also be lowered bodily to basement level for changes of scenery. As shown in the other section of Fig. 49.[1]

[1] Reproduced by kind permission from Macgowan's *Theatre of To-morrow*. Boni and Liveright, New York.

three complete settings can be arranged beforehand in the basement, and when the stage is lowered, the used setting can be slid bodily off to the side, a new setting slid into place, and the stage raised to its original level. So rapidly can a full setting be changed in this way, that only two minutes are required for the complete operation, and it is frequently found that the change is made far more quickly than the actors can get ready for the next scene.

The large dome at the back of the stage (kuppel-horizont) is constructed of plaster on an expanded metal framework, and occupies almost a separate quarter of the stage building, interfering very little with the ordinary stage routine. So much so, in fact, that the theatre could be used in the ordinary way to which we are accustomed in England, as there is ample space for flying scenery from the grid. It will be noticed that some of the back-cloths shown suspended are actually above the top of the dome, and to enable these to be lowered, the top of the dome is hinged. There is the slight disadvantage that the hinge line is visible, but only to the first two rows of stalls, and it is doubtful whether more than one playgoer in ten would observe it.

If this theatre were to be constructed at the present time, it would probably be equipped with Schwabe lighting. At the present time, the lighting of the acting-area is by the usual system, reinforced by three batteries of Linnebach lamps, shown in Fig. 48, with dotted lines to indicate the light coming from them. These batteries of lights consist of arc lamps contained in metal housings, open both back and front. Magazines with glass colour slides and shutters, connected with the switch board by tracker wires, allow the light to be altered or dimmed. The light coming from the back of the lamps impinges directly upon the dome, and that coming from the front of the lamp on to a white surface which reflects it down on to the stage as indirect light. The indirect lighting of the acting-area produces a subtle and peculiarly soft effect which is quite unique.

It is a modification of the Fortuny system of lighting, in which the light from arc lamps was reflected from bands of coloured silk, both on to the acting-area and the dome.

Both the Linnebach and Fortuny systems require a heavy current and entail considerable trouble and expense in the maintenance of the arc lamps, and in the case of the latter system the expense has been found to be altogether prohibitive. The dome is pierced by a number of very small holes, behind which electric lamps are placed for use as stars. It is worth particular notice that the switch board is situated under the front of the stage, the electricians having an uninterrupted view through a window in the centre of the footlights. The prompter is similarly accommodated.

It is only fair to say that although this theatre may be considered as practically perfect and capable of staging any kind of production, it would be entirely unsuitable for this country without State or Municipal aid. Although several times larger than the Drury Lane Theatre, London, it only seats 1300 people, and the price of the seats is less than half our usual West End prices. The mechanical equipment of the theatre enables the stage to be operated with a staff of fifty-two men, as against about two hundred employed in a London theatre of smaller size; but it must not be assumed from this that the total costs, with due regard to the original capital outlay, of operating the theatre in Dresden are smaller than London.

I regret the absence of a scale in the two sections of this theatre, but as a guide to the general size, the acting-area alone is about 90 feet square and the total height from the grid to the cellar is about 130 feet. I think these dimensions are only exceeded by the Opera House at Charlottenburg, Berlin, and La Scala, Milan.

Chapter VIII

METHODS OF PRESENTATION

The first duty of the electrician is to make the actors visible to the audience; his second is to aid the action and atmosphere of the play by doing this in a suitable manner. It is a favourite pastime with some critics to jibe at the scenic artist and electrician, and to maintain that their efforts detract from the acting. I would rather say that good acting can only be enhanced by suitable scenery and beautiful lighting, but it is a crime to spend time and money on scenery or lighting to the neglect of the acting. *It is also a crime to stage a bad play simply because it lends itself to spectacular effects.*

In the Commercial theatre it should be possible to achieve a combination of elaborate scenery and competent acting, but if the sum of money available for the production should be inadequate both for the initial outlay on scenery and also for the salaries of the best available actors, then, beyond all question, the scenery must be sacrificed to the acting. In the Little theatre, however, since the salaries of the actors do not affect the issue, the money spent on scenery does not detract from the efficiency of the production, but increases it in so far as elaborate scenery is desirable artistically for the particular play concerned. If the funds available for this purpose are insufficient to provide scenery of this kind, that is the best possible, it will be infinitely preferable to dispense with it entirely and to employ a simple and symbolical type of setting.

The question of scenery requires an artist and stage-carpenter for its discussion, and in this book it will be considered mostly from the point of view of lighting. A

few general suggestions will be made and a few hints given on what to be avoided.

The whole question of presenting plays should be viewed with an open mind. There is no definitely right or wrong way of staging most plays, unless they have deliberately been written with a view to special treatment. Many plays can be produced equally well in a variety of ways, Shakespeare's, for instance. As literature, Shakespeare can be presented without scenery or special lighting; as drama, with gorgeous and elaborate settings, or, taking the middle course, with a simple and suggestive arrangement of scenery and curtains, enlivened with light. The choice of method depends upon the producer and the means at hand. A realistic production is usually impossible on the grounds of expense, and realism should generally be avoided unless demanded by the play. All poetic works lose rather than gain by elaborate or realistic scenery and gain rather than lose by elaborate lighting. A producer should call upon the imagination of his audience, stimulate, and use it.

The great stand-by of the Little theatre has always been curtains. In all cases of difficulty the cry has been "use curtains." Now, simply to drape three sides of a stage with curtains, and leave it at that, means lazy and dull productions. To draw upon the imagination of an audience to the extent of asking them to accept the same curtains, arranged in the same way, both as a castle-banqueting-hall and as a forest is going too far. Another mistaken idea is to imagine curtains are a cheap form of scenery. Curtains are exceedingly expensive if of reasonably good material and properly made.

The best colour for curtains is a grey, or other pale neutral tint. This will take any coloured light, the alteration of which materially affects the changing of scene and place. Black curtains are also most useful for the opposite reason, they do not take coloured light, give an idea of depth and distance and give little trouble with shadows. They are a great help in throwing into relief bright costumes. Curtains should be light-proof

or there will be great trouble with any lighting effects behind them. This point is frequently forgotten until too late.

For a stage permanently equipped with curtains a good arrangement is to use a pale grey material such as

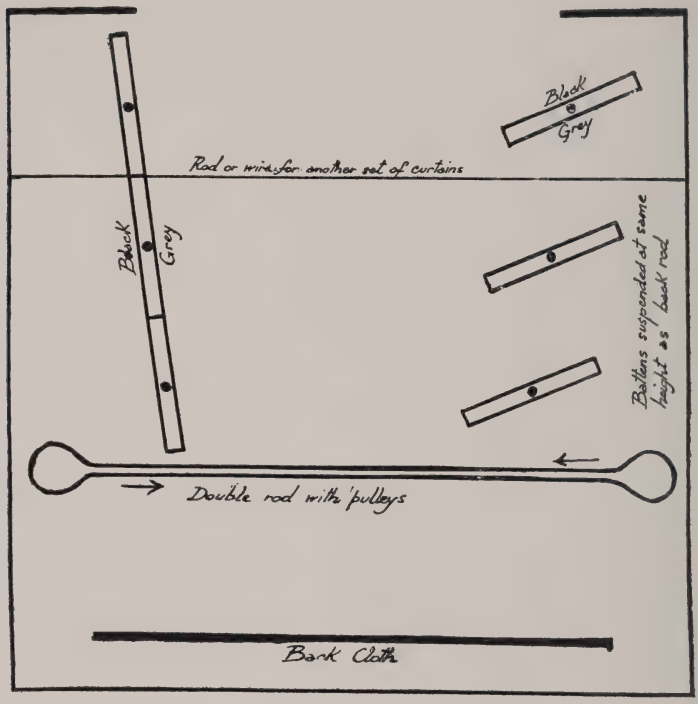


Fig. 50.

velveteen lined with black. These are light-proof and can be reversed. The material should be half as wide again as the width of the finished curtain so as to allow for pleating. The finished curtain may be fixed to a wooden batten, or if made to run on a rod or wire, hooks can be sewn on. Rings are better left on the rods, as it is convenient to be able to fix the curtains by their hooks on to a wire without undoing one end. If the modern type of flat rod and pulleys can be used at the back of the stage, it can be doubled on itself, and the

curtains be reversed without unhooking. The side curtains can be fixed on to wooden battens in three sections, arranged to pivot horizontally in the middle, thus allowing a change from grey to black or from a straight side to a set of wings. Fig. 50 shows a plan of the curtains in use. If, in addition, there is a back-cloth, so much the better. For open-air scenes, the black wings can be used with the back-cloth alone. Interiors can be greatly improved by using the complete set of grey curtains with door and window frames inserted. Exits and entrances are always a difficulty with curtain sets. The "Old Vic," London, has for many years used curtains most skilfully and artistically for its productions.

Expressionist plays, such as Elmer Rice's "The Adding Machine," can be produced adequately in black curtains with the addition of doors, windows and furniture for interiors, and appropriate "props" for exteriors. Thus a "Pleasant Place" is indicated by one tree, a green bank, and bright flowers; a grave-yard, by iron gates at the back and tomb-stones.

For modern realistic plays a permanent setting is very desirable. Sheldon Cheney, in his "The Art Theatre," has fully described and illustrated such a set, consisting of a number of interchangeable units, flats, door-pieces, window-pieces, arches and pylons. Such a setting is cheaper than a good complete set of curtains and far more useful for general work. For classical and similar plays the skeleton and certain units of the permanent setting can be used in combination with curtains or other draperies, borrowed or hired for the occasion. Permanent settings should be of a neutral colour so that any scheme of decoration may be used, and any coloured light that is desired.

The Scenic Artist.

Hitherto, scenery has been two-dimensional. Thus on a canvas possessing only height and breadth, the artist has frequently represented many yards or even

miles in perspective. However admirable may be his work as a pictorial effort it is bound to fail when the actor, a human measuring rod, is placed beside it. The artist can hold a high place in the theatre as a designer and as a painter, but he should work on new lines—three-dimensional instead of two. To-day three-dimensional scenery is firmly established in the theatre, and has called for new machinery for its manipulation. The old quick-change by back-drop, cut-cloths, borders, and wings dropped from the flies is no longer possible, and bridges and cuts have ceased to be as useful as heretofore. Their place has been taken by the wagon-stage and the sinking-and-sliding-stage. By these devices, hardly seen in this country as yet, a large number of built-up scenes may be used with but little time between each. Without special machinery, rostrums and solid units must be built up during a long interval, and the number of scenes is therefore limited.

In the Little theatre particularly, perspective painting had better be avoided entirely and the scenery limited as far as possible to objects in the fore-ground and distance. If the back-ground can be a cyclorama, or a plain blue cloth, ground rows placed only a foot or so in front of it will be found to give a much greater idea of distance than the old perspective painting. The mistake that is often made is to use a ground row to represent the middle distance, thus merely transferring the old form of scenic art to a new position. However well painted a back-cloth may be, the audience will always be able to guess its position within a few feet, but a cyclorama having no marks or creases and flooded evenly with light almost defies detection, and the effect of distance is amazing. Experiments in designing scenery on a stage model, which every serious stage artist should use, will soon bring conviction of this fact.

In using solid scenery the shadows should be obtained as far as may be by the lighting. The lighting, if from two directions and of two different colours, gives very beautiful shadow effects which greatly help the

Fig. 51.

Note natural shadows and high-lights super-imposed upon the normal lighting by powerful focus-lamp outside window.

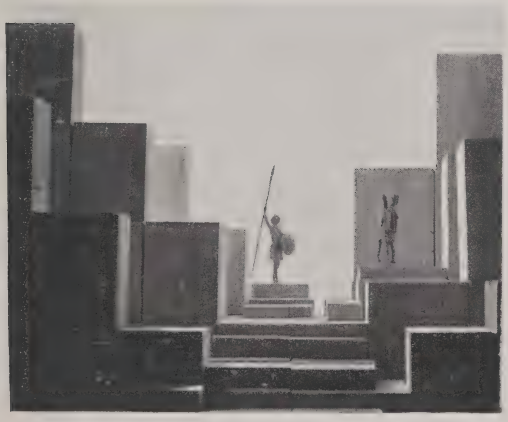


Fig. 52.

Here the high-lights are of a different colour to the shadows. Shadows are lit by the acting-area floods and high-lights by side floods, or focus-lamps if movement is restricted.

atmosphere of the scene. Sometimes lighting from one direction and allowing deep black shadows will be found effective.

For classical and romantic plays, Terence Gray has designed a cheap form of scenery which can be built up in an almost endless variety of ways. Figs. 51 and 52 illustrate two scenes, an interior and an exterior, both from his play "Cuchulainn."[1] The units consist of two sizes of wooden boxes, having a definite proportion to one another, and distempered a blue-grey. Packing-cases or the like may be used. They can be built up separately or bolted together in sets of a convenient number. Where storage room is available such a set saves a great deal of expense. In small theatres the units are easily handled, but in large ones the wagon-stage or sliding-and-sinking-stage would be necessary.

Psychological Lighting.

In poetical plays or in any play which is not mounted realistically, the producer can proceed boldly and unhesitatingly with the lighting. There is an idea prevalent that actors cannot perform in vividly coloured light. With the exception of one or two colours such as green, the acting-area can be lit with any colour suitable to the spirit of the scene. Shakespeare lends itself to such psychological lighting, as the scenes are often short and clear-cut. Herbert M. Prentice, in producing "Twelfth Night" for the Sheffield Repertory Company, used a simple setting in plain white, each scene being lit psychologically. He used a back-cloth of dark blue, in front of which was placed two groups of formal trees in dark green. Two feet in front of this was a white ground row four feet in height. Three white wings on each side completed the permanent setting. For the Duke's Palace, a cut-cloth, in the form of pillars and arches and hung level with the up-stage wings, was the only extra scenery required. For Olivia's room a cut-cloth representing a single arch was substituted for the first,

[1] Published by W. Heffer & Sons Ltd., Cambridge, 1925.

and black curtains hung behind. To change to the garden scene the curtain were removed and a rostrum and steps introduced. The street scene, probably the most effective, consisted of the permanent set with a flat and "return" projecting half way across the stage, and upon which a formal window and door appeared in black paint. The lighting was from four powerful floods at the back, behind the up-stage wings, combined with a batten, and a length behind the ground row. A few lamps, dipped blue, were necessary behind each tree to kill its shadow on the back-cloth. The acting-area was lit by floods 8 feet above the stage in front of each wing, and over the proscenium opening. No foot-lights were used, and no lighting from the front of the house. A few examples of the psychological lighting of this play may be mentioned:—

Scene.	*Spirit of Scene.*	*Lighting.*
Duke's Palace	Love	Front—Pink Back—Blue
Olivia's Room	Melancholy	Front—Amber Back—Green
Olivia's Room	Drunken Revelry	Front—Blue Back—Magenta
Olivia's Garden	Reconciliation	Front—Pink Back—Moonlight green

In the hands of a producer with imagination this system of lighting has infinite possibilities. It should be noted that when using plain white scenery the light should always be coloured, otherwise the scene will look bald and flat, and the glare will be very trying to the audience. Simple, two-dimensional scenery such as the above may, instead of suggesting any particular place, be used by the futuristic or impressionistic artist to symbolise anything he may desire, but he will be well advised to rely on light rather than pigments in completing his design.

PROJECTIONS.

The projection of scenery or any suitable design upon the background or cyclorama has not been fully exploited either is this country or abroad, and is the most probable future development in the theatre. A number of experiments have been carried out, however. A complete Schwabe installation has, in addition to the horizon lamps and cloud apparatus, large 3000 watt projectors, which can be used for additional clouds, panoramas or other designs. Dr. Hilar, in his productions at the National Theatre, Prague, has projected designs upon the cyclorama, using a powerful apparatus in the nature of a magic lantern, the slides being made of glass with the designs painted upon them, and these were kept cool by means of cold water circulated through the apparatus. His most successful experiment in this direction was in the Insect Play by Karel Capek.

In this country Mr. George Harris used a design in the last act of R.U.R. which was made up of coloured gelatine on a wooden framework about 4 feet square. This framework stood in the wings, the light being projected through it from an enclosed arc (practically a shadowgraph). In order to correct the distortions produced on the back cloth, the design itself had to be constructed with the distortions in the opposite direction.

Another apparatus which has been experimented with in England is called the "Mutochrome," a description of which, with illustrations, is given in "Colour Music," mentioned in the bibliography.

There are three problems which have to be faced when projecting scenery. The first is distortion. As it is not possible to place the projection apparatus in the most convenient place, that is in the centre of the acting-area; but either above or to one side, in such a position that the actors' shadows will not be thrown upon the background, it is obvious that the image thrown even upon a flat back-cloth will be seriously distorted. The suggested method of preparing the necessarily distorted "lantern slides" is first to construct a large-scale model

of the theatre; then the scene designer draws his design as he wishes it to appear, either on the flat background or the curved cyclorama. The design is then photographed from the position on the model which is afterwards to be occupied by the projection apparatus in the theatre. Having prepared a distorted lantern slide by this means we are faced with problem No. 2, the perishability of the lantern slide. Even if the heat generated in a powerful projector is eliminated by sufficient cooling, the light passing through the lantern slide is so intense that there is serious danger of the photographic plate being cracked and of any colours being bleached. If the lantern slides are moved through the apparatus, as in the ordinary "effect" projectors the problem is not so difficult, but for a scene design on a slide which remains stationary, no perfect solution has yet been found. Painted glass has been used and sheets of mica painted with analine dyes. Coloured gelatine is not satisfactory in small sizes, and large frames such as that used by Harris are unwieldy and difficult to construct.

The third problem is bound up with the design of the theatre. In theatres where the cyclorama is not far away from the acting-area it is very difficult to produce an image so bright that it will not be killed by the indirect light reflected off the stage floor and the scenery. When one remembers that the striking of a match in an ordinary room ruins a magic lantern show, the difficulties of scenery projection will be grasped. In any case the projector for this type of work must be very powerful and similar to that used for long throws in kinemas. That is, some apparatus such as a Beck arc, which takes 130 to 150 amperes. The problems of heat, and light intensity, from such a projector have been noted above under the heading of perishability of the slides. In the German theatres the problem is not nearly so difficult, because there the cycloramas are so far away from the acting-area that there exists what one might term "a no-man's land" between the two and the cyclorama can be left dark, practically speaking,

and is therefore comparable to an ordinary magic lantern sheet in a dark room.

To sum up, any one intending to build a theatre with a view to using projected scenery should construct the cyclorama at the very least 30 feet behind the point where any actor will be allowed to stand.

FESTIVAL THEATRE, CAMBRIDGE.

Realism is not practised in this theatre, and it is not possible for a repertory company to mount every production, produced for seven performances, as though it were for a run in the West End of London. It may be mentioned in passing that this is a professional Repertory Theatre.

The permanent equipment consists of many dozens of screens made of three-ply wood, which can be used separately or hinged together; they are all 4 feet wide and vary in height from 10 to 18 feet; two dozen half-round columns of various heights made of three-ply wood; several dozen rectangular units, sets of rostrums and steps, the latter both semi-circular, triangular, and rectangular. The dimensions of the separate units of this scenery allow it to be built up in any way, as with a child's box of bricks.

Both sets of curtains, used in front of the stage and at the bridge line, respectively, are interchangeable and reversible. Likewise the two sets of curtains which run on rails round the cyclorama, and half-way between it and the lighting bridge, are also reversible and interchangeable during the action of the play, by a system of switch-arms and points similar to those used on a railway.

With this equipment and a nucleus wardrobe of costumes, less historical than typical and representative, it is possible to stage a fresh production during each week of the University term.

It may be of interest to most readers if I conclude this chapter with actual photographs of settings used at the above and other theatres, with a description of the lighting used. The numbers placed after the colours refer to the gelatine mediums supplied by Messrs. Digby, Gerrard Street, London. A list appears at the end of the book.

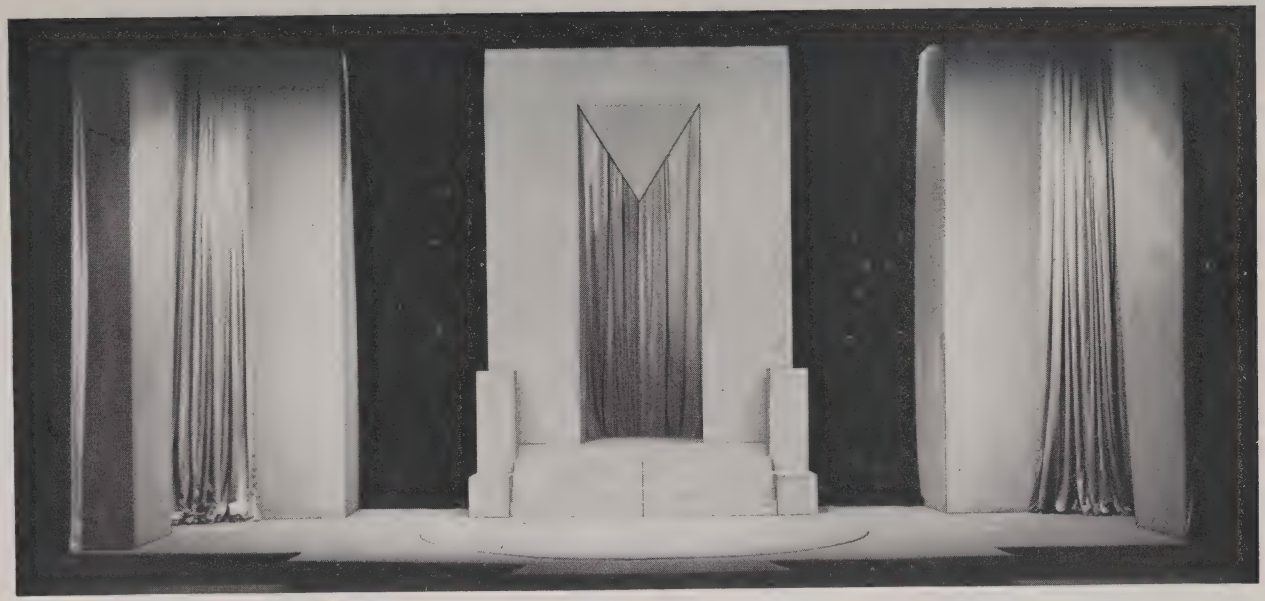
The Oresteia of Aeschylus. *The Agamemnon.*

Fig. 53.

The scene was built of screens and rostrums painted a neutral grey, with curtains of grey and black. The lighting was changed considerably during the scene, but the basic idea was as follows:—Acting-area lighting, green No. 15 in the centre on the steps, with a pool of dark blue No. 24 to the left and right from the spot batten. The curtains through the doorway were flooded with violet No. 16 from flood lamps standing on the stage at each side. The fore-stage steps were flooded with dark blue No. 24 in the centre and green No. 15 at each side from the gallery focus lamps.

Upon each entrance of Klytaemnestra and Orestes a sharp shaft of bright green No. 15 was thrown on to the steps in front of the entrance to the palace. This light, apart from having the effect of focussing attention on the characters, greatly contributed to the creation of the impending tragedy.

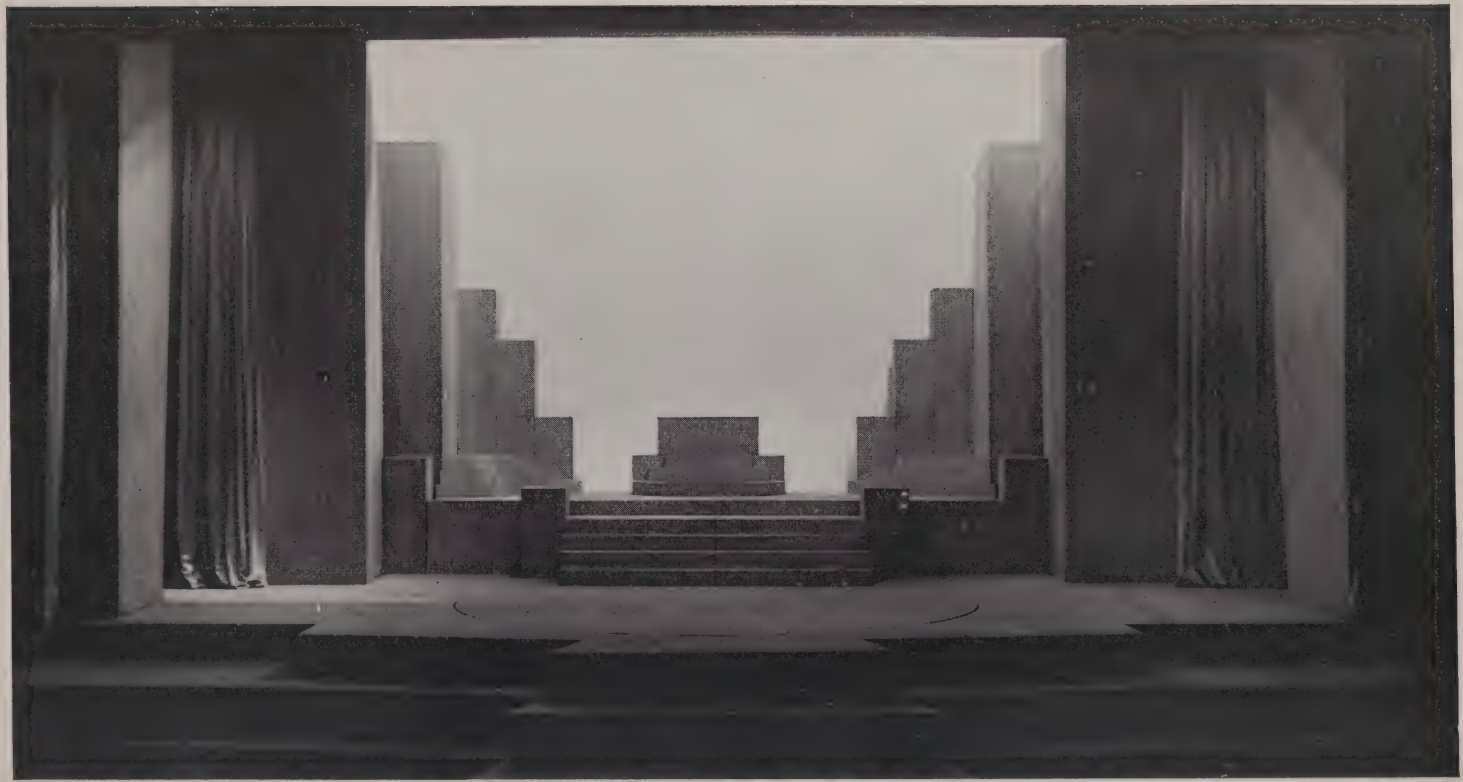
The lamp was used without focussing frost, which made the shaft severe and concentrated.



Designed and Produced by Herbert M. Prentice.

THE ORESTEIA OF AESCHYLUS.
The Agamemnon.
Fig. 53.

Scott & Wilkinson, Cambridge. Festival Theatre, 1926.



Designed and Produced by Herbert M. Prentice.

THE ORESTEIA OF AESCHYLUS.
Scene : The Areopagus.

Scott & Wilkinson, Cambridge. Festival Theatre, 1926.

Fig. 54.

The Oresteia of Aeschylus. *The Areopagus.*

Fig. 54.

The cyclorama was flooded with dark blue with a blaze of green No. 15 behind the throne in the centre, this being done by two flood lights actually concealed in the throne itself. For the acting-area, violet No. 16 on the steps and centre, dark blue No. 24 at each side, and on the fore stage steps dark blue and green as in the last scene. The group of furies who stood on the fore stage steps were lit with red No. 8.

The light from the Schwabe lamp on the bridge caught the tops of the tall screens, thus painting them with light, dark blue at the top, gradually blending into the violet light No. 16 at the base, especially on the diagonal steps and inner screens.

Heraclius.

Fig. 55.

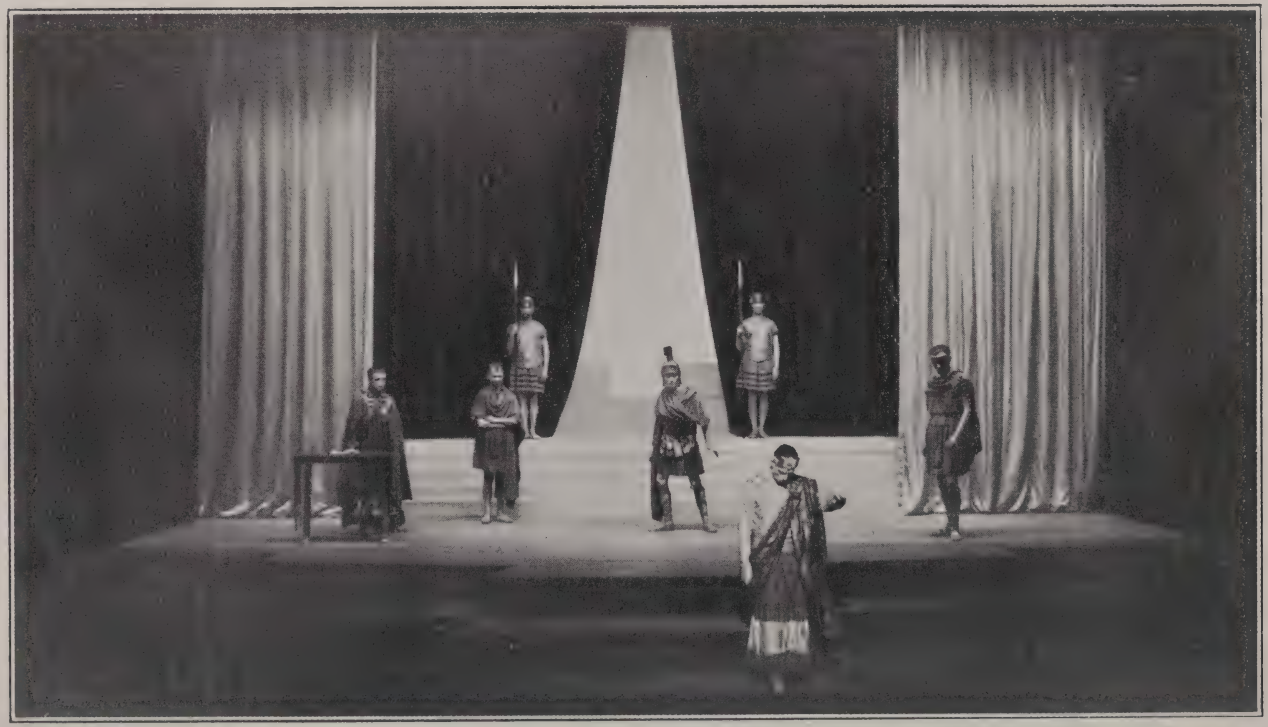
The scenery was painted with aluminium paint, with cerise bordering; curtains silver; sky, seen through the centre archway, turquoise. The backing behind the arches on the right and left was lit by floods with violet No. 16 and dark blue No. 24 respectively. The acting-area was evenly flooded from the batten with purple (red plus blue). This was reinforced on the steps in the centre by violet No. 16 from the spot batten and dark blue No. 24 from the side. The fore-stage was lit from the gallery focus-lamps with moonlight green No. 13 in the centre and blue No. 18 at the sides.

In addition to this there was an open flood lamp suspended from the spot batten with No. 3 (dark amber) and frost, which was used in the last act, when the scene was carried out with curtains instead of screens. (See Fig. 56.)

Designed and Produced by Herbert M. Prentice.

HERACLIUS. *Scott & Wilkinson, Cambridge.*
By T. E. Ellis. *By kind permission from "The Lady."*
Scene 1 : Atrium of the Chalke Palace. *Festival Theatre,* 1927.

Fig. 55.



Designed and Produced by Herbert M. Prentice.

HERACLIUS.
By T. E. Ellis.
Scene 8: The Atrium of the Chalke Palace.

Scott & Wilkinson, Cambridge.
Festival Theatre, 1927.

Fig. 56.

The Rumour. By C. K. Munro.

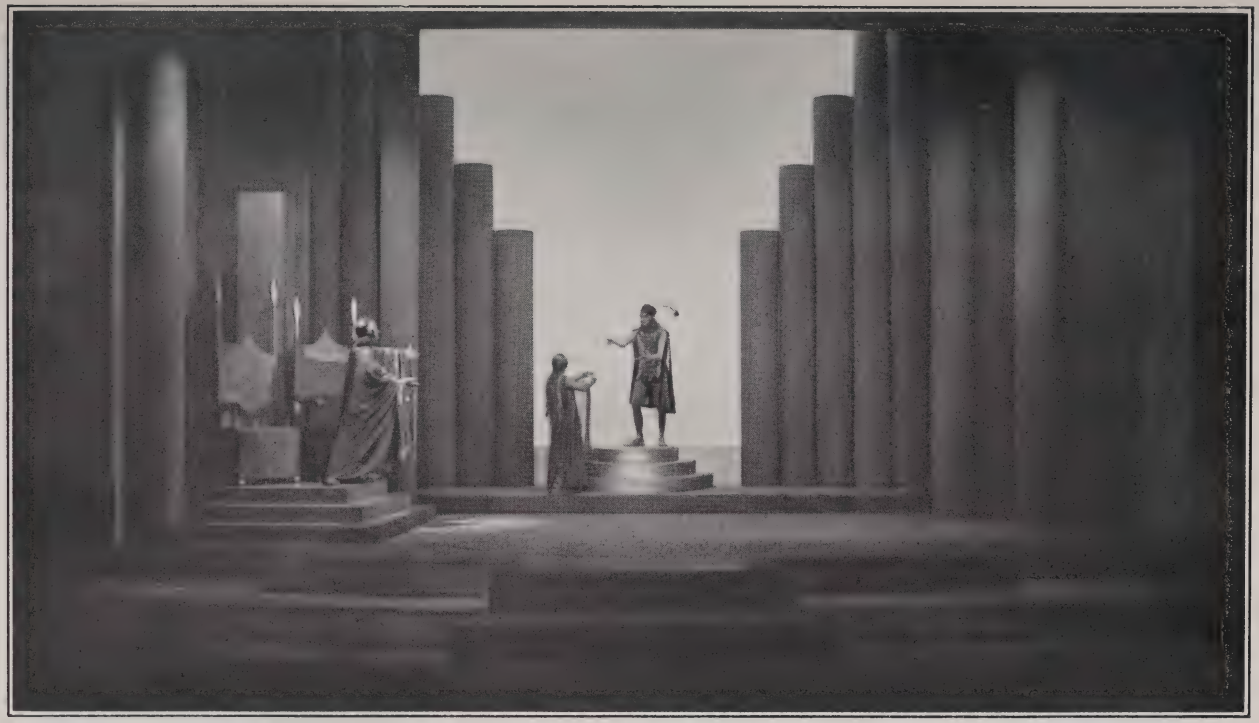
There were no less than eighteen scenes in this production, and it was essential that scene should follow scene with the greatest rapidity. The producer, Norman Marshall, used hardly any scenery, and relied chiefly on lighting to suggest the various changes. For instance, the play opened with a scene in a smoking-room, for which three chairs and a small table were grouped together at the front of the stage, and lit solely by a red spot concealed in a trap on the fore-stage, which gave the impression of firelight. This, combined with the fact that black curtains were drawn across the cyclorama, left the greater part of the stage so dark that it was possible to have the next scene set ready. This, an office, was suggested merely by a desk and chair in a concentrated pool of light, which again left much of the stage in complete darkness, so that another office could be set on the other side of the stage, and similarly lit in its turn. Yet another office scene, this time a very brief one, was suggested simply by a baby spot on the face of a man speaking at the telephone, nothing else being visible. A rather similar method was used for the street scenes, a single spot from the spot-batten suggesting the light from a street-lamp, without anything else on the stage.

The Immortal Hour.

Fig 57.

The pillars were emerald green, with the centre steps in gold and the throne scarlet and gold. The cyclorama was flooded with orange. The steps were lit from the spot-batten with light yellow No. 2. The thrones were lit from the spot-batten with a mixture of red and blue. A spot-light on the batten immediately above the thrones projected a pool of white light on the throne steps. The central entrance at the back was by a flight of steps from the cellar to stage level, lit by a vertical shaft of green No. 15, coming from a focus-lamp below.

At the beginning of the scene the acting-area was flooded with amber and was gradually dimmed after the entrance of Midir. As the scene progressed and Midir influenced Etain and drew her towards the central steps away from the King, the light changed very gradually to green, this in turn fading as the two mounted the steps at the entrance. By the time they had reached the top they were standing in a pool of green light, then as they descended into their own "realm" the light from the pit was increased so that they were, in effect, swallowed up in a blaze of green light. This was dimmed gradually as they disappeared from view, leaving the stage almost in total darkness a concentrated white spot being brought up rapidly on the dimmer to pick out the King as he stood on the steps of his throne, until Dalua's shadow passed over him and he falls dead.



Designed and Produced by Herbert M. Prentice.

THE IMMORTAL HOUR.
By Fiona Macleod.
Act II.
Fig. 57.

Scott & Wilkinson, Cambridge. Festival Theatre, 1927.

Designed and Produced by Herbert M. Prentice.

THE ADDING MACHINE.
By Elmer Rice.
Scene : A Pleasant Place.
Fig. 58

Scott & Wilkinson, Cambridge. Festival Theatre, 1927.

The Adding Machine.

Figs. 58 and 59.

The whole of the lighting in this production was as severe as the scenery.

The producer (Herbert M. Prentice) aimed at obtaining the effect of not actually witnessing the scene, but at the effect in one's mind of "having witnessed" it. In other words, what was witnessed on the stage was the essence of the incidents, stripped of all superfluous and extraneous matter. Consequently throughout the production there were no curves, the whole designs being carried out in straight lines and angles *including the facial make-up*, and the movements of the characters.

As regards the lighting, there was no "flooding" of a scene. Each object, group or individual, was picked out by a sharp shaft of hard white light (in most cases). When occasion demanded, a coloured shaft of light was used, as for example, when Zero returned to the house after the murder of the Boss, he was picked out by a blood-red No. 8 spot, whilst Mrs. Zero and the two groups of guests were picked out with concentrated shafts of white light.

The graveyard scene was the subject of an experiment. The graves, railings, etc., were painted with luminous paint, a fluorescent grease paint being used for the make-up of the characters. The whole stage was flooded with ultra-violet light from arc lamps fitted with special glass screens which filtered off all the visible rays. (Mercury vapour lamps, though expensive, are more efficient than carbon or tungsten arcs for this purpose, but great care is necessary in handling them, and the operators' eyes should be protected by special glasses when adjusting the lamps ready for use.)

The scene illustrated in Fig. 58 is "a pleasant place." This was indicated without any attempt at reality, with

The Adding Machine—*continued.*

a formal tree and ground rows carried out in blue, emerald green, gold, red, and black. The cyclorama was lit with magenta (red plus blue), the tree by a spot light with daylight blue No. 10 and the ground rows by spots, violet No. 16 and daylight blue No. 10. The only acting-area lighting was a pool of light up stage left, dark pink No. 6 from the spot-batten.

Fig. 59, illustrating the last scene, "another office," had only the machine in the centre of the stage, illuminated by a shaft of white light immediately above. The cyclorama was lit at the bottom with dim red, the grotesque shadows on the upper portion being thrown by the Schwabe equipment on the bridge by the light of one naked 200 watt lamp used normally as a working light during scene changes.

Designed and Produced by Herbert M. Prentice.

THE ADDING MACHINE.
By Elmer Rice.
Last Scene : Another Office.

Scott & Wilkinson, Cambridge.
Festival Theatre, 1927.

Fig. 59.

Designed and lit by C. Harold Ridge.
Executed by Michael Hampton.
Produced by Herbert M. Prentice.

THE PLEASURE GARDEN.
By Beatrice Mayor.

Scott & Wilkinson, Cambridge.
Festival Theatre, 1927.

Fig. 60.

The Pleasure Garden.

Fig. 60.

This setting gives an excellent idea of how the cyclorama saves the necessity of using large quantities of scenery. Practically speaking, the stage is bare. There was no attempt to mount this play realistically. The sides of the stage were masked by simple and suggestive tree-forms in browns, greens and reds, the horizon line being broken at the back by a low ground-row with the addition of two small tree-forms in three-ply wood, coloured in brown, blue and green.

The lighting was designed merely to give the atmosphere of the play, but some sort of realism was inevitable in doing this. The principal acting-area lighting was worked through perforated screens to give a mottled effect on the stage front, as of light coming through leaves and branches of trees. The time of the action is from early summer afternoon to sunset. At the beginning of the play the top of the cyclorama was a very pale blue, using the Schwabe dark blue, middle blue, light blue, and daylight blue lamps at full, fading to a hazy white on the horizon, this being obtained by using a mixture of blue and green from below stage level. During the progress of the first scene the daylight Schwabe lamps were dimmed, thus slightly increasing the depth of the blue in the sky. For the acting-area the general lighting was by a mixture of red and green from the batten (giving light amber). Stage left, which was supposed to be in shadow and which one might imagine should be lit with blue, was actually lit with red from a focus-lamp. This gave the idea of heat, whereas a blue shadow gave coolness. Stage right was intended to be lit by a shaft of sunlight coming through the trees, No. 17, from a focus-lamp on the spot-batten stage left. This lamp was fitted with a condenser instead of the

The Pleasure Garden—*continued.*

usual plano-convex lens, and a distorted image of the lamp filament allowed to fall on the floor to keep up the appearance of light coming through foliage. As may be seen in the picture, sharp shadows were thrown on the scenery. During the progress of the play, the upper part of the cyclorama became a deeper blue by the successive dimming of the light blue and middle blue Schwabe lamps, the bottom portion becoming yellower and finally dark amber by gradually removing the blue and adding red in the pit lamps. The acting-area was altered in a similar way by taking down the green in the batten. The patch of sunlight on stage right was first altered, lengthening the shadows by the use of the focus-lamp shown on the return of the dress circle stage left, with a darker medium No. 6, this lamp being dimmed completely out before the end of the play.

Love for Love.

Fig. 61.

In this scene the dark curtains were flooded with amber light from the Schwabe lamps on the "bridge." As the draped grey curtains were hung between the lamps and the dark curtains, the tops of the latter caught the light, thus making them a rich gold. In another scene of the same setting, blue or violet light was used by a mixture of blue and red lamps.

The acting-area was lit by frosted spots of blue and amber (Nos. 24 and 3).

Designed and Produced by Herbert M. Prentice.

Congreves' LOVE FOR LOVE.

Fig. 61.

Scott & Wilkinson, Cambridge. Festival Theatre, 1927.

Designed by Michael Hampton.
Produced by Norman Marshall.

THE INSECT PLAY.
By The Brothers Capek.
Creepers and Crawlers.

Scott & Wilkinson, Cambridge.
Festival Theatre, 1927.

Fig. 62.

The Insect Play. *Act II. Creepers and Crawlers.*

Fig. 62.

This very effective set consists of side pieces as in "The Pleasure Garden," repainted in brown and emerald green, with high ground-rows at the back, carried out in two shades of brown, with emerald green edging.

In lighting the scene the producer aimed at a sultry, parched atmosphere. The lighting of the cyclorama was a rather hot, dry orange, and the acting-area was mainly a huge pool of deep amber, No. 3, from the front-of-the-house focus lamps. The use of so much amber in this scene was justified by the fact that costumes and scenery were almost entirely in drab colourings.

The Insect Play. *Act III. The Ants.*

Fig. 63.

The side scenery is black, and the remainder consists of two central pillars, built in at the bottom with rectangular units, and semi-circular steps stood on edge. Three-ply wheels are suspended from the bridge. Colouring in grey, red and black.

During the early part of the act the cyclorama was lit from the bottom with a glow of red, the only other lighting being pale amber spots on the three figures in the centre of the stage. After the declaration of war, halfway through the scene, the red on the cyclorama leapt up, flooding the whole of it, and gigantic shadows of machinery working at furious speed were projected upon the upper part of the cyclorama from optical projector lanterns. The spots on the figures in the middle of the stage changed to deep red, so that the endless stream of ants was seen mainly in silhouette.

Designed by Michael Hampton.
Produced by Norman Marshall.

THE INSECT PLAY.
By the Brothers Capek.
"The Ants."

Scott & Wilkinson, Cambridge.
Festival Theatre.

Fig. 63.

Designed by Terence Gray.
Produced by Norman Marshall.

On Baile's Strand.
By W. B. Yeats.

Scott & Wilkinson, Cambridge.
Festival Theatre, 1927.

Fig. 64.

On Baile's Strand.

Fig. 64.

This very simple setting consists of nothing more than a line of rostra and steps across the back of the stage, and pillars arranged in groups of three; all painted a neutral grey.

The lighting on the cyclorama sought to suggest the mist rising from the sea, and was obtained by a mixture from the Schwabe lamps of blues and green. The acting-area was lit solely by two spot-lights from the spot batten, and the spot on the throne was directed so that a good effect was obtained by the shaft of light striking the pillars, as may be seen in the photograph. Towards the end of the play the spots faded out, and the final scene was played in silhouette.

"And in the Tomb were found . . . ."

Fig. 65.

The lighting throughout was used to gain atmosphere alone, and there was no general flooding except on the cyclorama. For this reason and because the principal costumes were white, and the scenery very simple with brilliant Egyptian decoration, the photographs in monochrome do not do justice to the play.

Fig. 65 shows an example of a very effective silhouette, and is reproduced for that reason.

Designed by Terence Gray and Doria Paston.
Produced by Herbert M. Prentice.

"AND IN THE TOMB WERE FOUND. . . ."
By Terence Gray.
Final tableau.
Fig. 65.

Scott & Wilkinson, Cambridge.
Festival Theatre, 1927.

Designed and Produced by Roland T. F. Crossley.

JUDGE OF ALL THE EARTH.
By Stephen Schofield.

By permission of "Drama." Rowntree Players, York.

Fig. 66.

The Judge of All the Earth.

Fig. 66.

This play by Stephen Schofield was recently performed by the Rowntree Players at York during the National Festival of Community Drama organised by the British Drama League. This is an entirely amateur company without professional assistance. The design for the setting shown in Fig. 66 is an excellent example of the tremendous progress now being made in the Little theatre world.

The play itself has ideas and some originality, but as actually written it is very weak. The main interest lies in the treatment by the producer, and I cannot do better than quote his own words on the subject.

"You ask me for reasons for the design and lighting . . . I used that design and lighting since it seemed to me the only possibility for a setting for the Judgement Seat of God in that play. No one I know has ever seen the Judgement Seat of God and so I was forced on to imagination. The cubist method seemed to me appropriate because of the essential simplicity and strength of it. It is almost crystalline, and as such, is nearer to the beginning of things as I see it, and has the hard clear beauty of eternal beginning. Lines and masses are straight and clear at this Seat, without the fogging of outlines and compromising of curves. So should our actions appear at the Judgement Seat. The general lines of course lead the eye to the throne as the centre of interest and at the same time give the upward line of aspiration and the bend of worship.

"These masses, orange coloured, stood out against a background of blue light, obtained by strong hidden floods shining on to light coloured curtains. So your figures are seen largely in silhouette and very much two-dimensional. This should give a certain unreality to the figures for the earlier part of the play, and not until they really find themselves at the end do they appear as wholly real, when a white spot-light picks them out seated on the throne.

"Needless to say it is necessary to depart largely from the orthodox method of acting, and positions and gestures have

The Judge of All the Earth—*continued.*

to be worked out to fit in with the design and harmonise or clash according to the emotion of the play.

"This whole matter of lighting is one of great importance in our theatre of to-day and the future. No longer must it be allowed to be mere illumination, but light and shade must be brought to the help of the changing feeling of the play. It is possible for your lighting to take as important an emotional part in your play as the actors. Recently in a production of 'Masses and Man' by Ernst Toller, I worked exclusively with limes, against a background of black curtains, and with only a black rostrum on the stage. The whole setting and emotion of the play was put over by the swing of the beams of light and the throb of their varying intensity. A pulsing of the light can work upon your audience as much or more than your best actor, and should be treated as a necessary part of the movement of your play and not as mere illumination. . . ."

Pelleas et Melisande.

Fig. 67.

This Opera was produced in the Parry Opera Theatre at the Royal College of Music, London, by Mr. H. Procter-Gregg. His design for Act I, Scene 3, is shown in Fig. 67, and the following is his own description of the lighting:—

"This was about the most difficult scene to light I have ever known: it took more time than the remaining twelve scenes of the Opera together. Also the 'check' has to work smoothly and accurately to the score, arriving at particular points at particular bars—twice out of six times it got mistimed by a few seconds. In this most Maeterlinckian of scenes atmosphere is everything—miss the subtle effect of twilight going breathlessly into a night heavy with storm—opening too with a calm sunset——miss all that, and your audience had better keep its eyes shut and listen to the words. Three people meet on a terrace overlooking the sea and discuss the weather, two of them lovers meeting *for the first time*: they allude only to the weather, lighthouses, ships setting sail, the bustle of mariners in the port far below, but the unfolding of the whole drama is symbolised meteorologically in that seven minutes at most! Omit the lighthouses, etc., and try to convey visually the following impression:—(I quote

Design by H. Procter-Gregg.

PELLEAS AND MELISANDE.
By Maeterlinck.
Act I. Scene 3.
Fig. 67.

Parry Opera Theatre.
Royal College of Music, London, 1927.

Pelleas et Melisande—*continued.*

the opening lines, omitting merely the conventionalities of greeting):—

"'Il fait sombre dans les jardins. Et quelles forêts, quelles forêts autour des palais! . . . Il y a des endroits ou l'on ne voit jamais le soleil. Regardez de l'autre côté, vous aurez la clarté de la mer. . . Nous aussi, nous cherchions la clarté—ici il fait un peu plus clair qu'ailleurs, et cependent la mer est sombre. Nous aurons une tempête cette nuit; il y en a toutes les nuits depuis quelque temps, et cependent elle est si calme maintenant: . . . On s'embarquerait sans la savoir, et l'on ne reviendrait plus . . .'

"Vague, yes, most deliberately and accurately vague. This dialogue must be *lit*, delicately and suggestively. This is not producer's jargon: it is simply up to the scene director to interpret Maeterlinck to the eye, or let Maeterlinck look and sound silly.

"This is how we tried to do it, scorning the discreet 'general check' of the stock opera-house—I give an untechnical precis of the plot.

"Scene: a break in a pine forest giving on a terrace, sea supposed far below: steps descend that way. All top-lighting dark blue, 3 shades, one patch of green which checks first. Two circuits of orange (spots and floods) set to throw long pools of sunset light through the branches on to the stage and pick up the figures on the terrace, and set low, to throw long shadows. Horizon dark blue above a misty green-blue below (a little *reflected* light from the orange circuits striking stage, etc., helped this). The 'orange' checked first, to out, one circuit at back changed to green to pick up the two figures left on the terrace. Meantime everything else 'to out' working front to back, leaving only one cloud lantern to light the whole sky with a judicious "leak" arranged to drop a faint, unseen ray on the lovers descending from the terrace. The "cloud' was a brown paper affair, mostly mask, with suitable coloured slits. One must remember that 'black clouds' are impossible on a white or nearly white cyclorama. (See page 122.)

"The difficulties of all this were of course:—

(1) Timing.

(2) Keeping a balance and avoiding unintended shadows.

(3) Setting the spots accurately in the rapid scene-change preceding."

Richard III.

Figs. 68, 69 and 70.

The production of Richard III, which is here illustrated, involved the putting into practice of a number of novel features of stage-craft, a brief description of which may be of interest.

The principles underlying this experiment were as follows:—Fundamentally it was an attempt to give back to Shakespeare the method of production which was in use in his own day—that is the method for which the plays were actually written—but on a higher level of the spiral of evolution, i.e. by applying to the Shakespearian method of cursory indication of scene much of the development of stage-craft which the intervening centuries have placed it in our power to use. In this particular theory Shakespeare's plays are essentially three-dimensional and therefore cannot be squeezed behind a proscenium without losing their three-dimensional character. Behind a proscenium they not only lose their shape, but they lose one dimension of their being, for the action is almost exclusively across the spectator's line of vision.

The play was reduced to essentials, only the great scenes and the connecting material being performed. The connecting material was played mostly in the auditorium or on the fore-stage steps and all asides were spoken to individual members of the public. The main scenes were divided into four series in all of which were used a turn-table, on which a structure of steps or spiral platforms or units was placed and revolved for different scenes, each scene symbolising the scene of action, and the characters being raised to different levels on these structures to emphasise the relationship existing between them.

Fig. 68 shows both sides of the most interesting setting used on the turn-table in Acts III and IV. On referring back to Fig. 44, it will be seen that the turn-table is 15

Richard III—*continued.*

feet in diameter, turned from below by hand-gearing. The structure illustrated is built from the permanent equipment of the theatre mentioned earlier in this chapter. In Act III, Scene 4, the position shown in Fig. 68 (a) was used. Scene 5 was played in front of Fig. 68 (b) but with the table revolved so that the part shown on the right was turned towards the audience. Scene 7 the same, (Scene 6 being omitted). Gloucester's exit in Scene 7 was made up the steps shown in Fig. 68(a), and it is to be especially noted that the audience were able to see both the exterior scene with the Lord Mayor and Buckingham and the interior scene in which Gloucester could be observed disguising two of his friends as the bishops (a good point this). On the "re-entrance of Gloucester aloft between two Bishops" the table was slowly revolved to the position shown in Fig. 68 (b). It must be realised that the table is not only revolved during intervals of darkness or behind closed curtains but, when desirable, during the actual progress of a scene, so as to show always the most significant aspect to the audience. Act IV, Scene 1, was omitted—Scene 2 was the same setting as Fig. 68 (a). For the remainder of the play the structure was entirely changed.

The principle of emphasising the essentials was carried out in all aspects of the production. The lighting was by means of focus-lamps only, often only one being used at a time, the characters in conflict at the moment alone being picked out from the surrounding darkness. The colour media most frequently used were middle-blue No. 18, and violets Nos. 22 and 16, middle-blue giving a hard light which brought up the primary colours (red, blue and green) in the costumes in the greatest contrast to one another, and the violets being used to emphasise the atmosphere of plotting and deeds of darkness. The action was likewise largely symbolical. No properties were used, so that the attention of the spectators should not be distracted by unessentials, an experiment which demonstrated that the action of slaying, of rewarding,

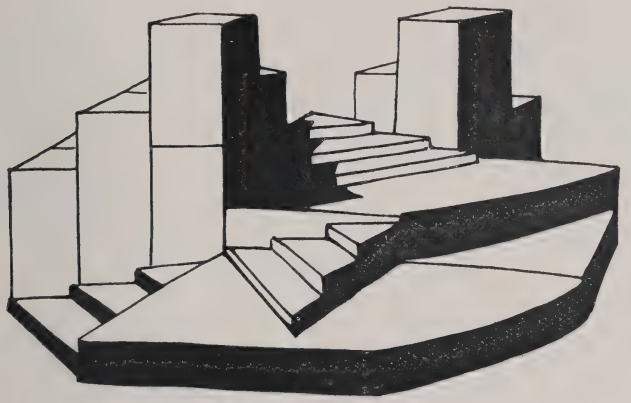


Fig. 68a.

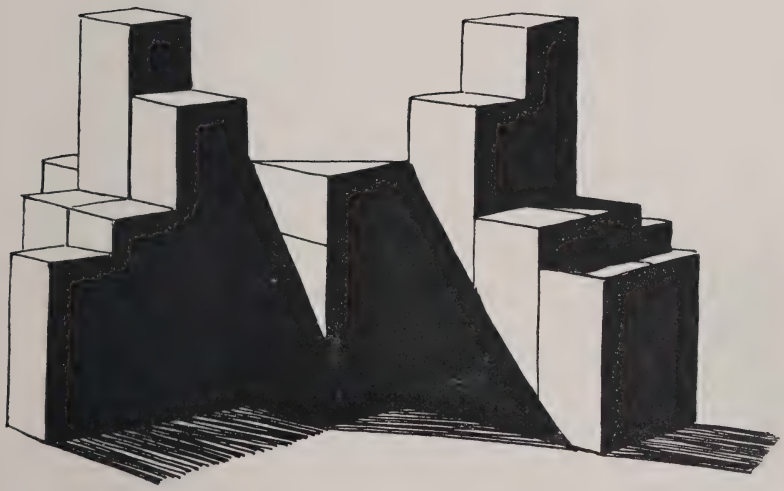


Fig. 68b.

Diagram showing two aspects of Constructivist Setting for Richard III, Act III, set on a turn table.

Designed and Produced by Terence Gray.

RICHARD III.
Act V, Sc. 3.

Scott & Wilkinson, Cambridge.
Festival Theatre, 1928.

"Let me sit heavy on thy soul to-morrow!
. . . . And fall thy edgeless sword: despair and die!"

Fig. 69.

Richard III—*continued.*

of crowning, is not less but more impressive when performed symbolically than when performed with an unconvincing property.

There is an apparent inconsistency between the statement above, that no properties were used and the photograph (Fig. 70) which shows the use of four spears. Since there was a definite symbolical value in the spears for gaining the desired effect, and since no principle, but merely an objective result, was involved, in this single instance an exception was made. It is suggested that in every application of this system of production a property should be introduced when—and only when—it can be given definite dramatic significance.

The essential features underlying this production were (1) the forswearing of any attempt at creating an illusion of place, a frank acceptance of the fact of stage and auditorium, (2) the restoration to Shakespeare of his essentially three-dimensional character, (3) the development of a scenic medium of expression which by symbol, by form, by colour and by variation of levels shall make it possible to emphasise the significance of each scene, (4) the utilisation of costume to serve the same ends as the setting, i.e. as an independent medium of expression. Instead of trying to reproduce on the stage the costumes worn at a certain period of history, in a play which, while it purports to deal with that period, actually has in it no element of historical reconstruction whatever, but merely utilises a convenient historical subject as framework for essentially subjective creation, the form and colour of costumes was employed to clarify the action of the play, to differentiate the elements in the conflicting parties, to symbolise their basic characters and to form effective decorative patterns, (5) the use of movement as an independent medium of expression, movement—outside the gestures and motions necessitated by the basic physical action, outside the range of naturalistic acting, and (6) the use of sound, human or mechanical, in the same way and to the same end, outside the normal requirements of the verse.

Designed and Produced by Terence Gray.

RICHARD III.
Act V, Sc. 4.
King Richard. "A horse! a horse! my kingdom for a horse!"
Act V, Sc. 5.
Richmond. ". . . . The day is ours; the bloody dog is dead."

Scott & Wilkinson, Cambridge.
Festival Theatre, 1928.

Fig. 70.

The Provoked Wife.

Frontispiece.

is an attempt to show the depth and atmosphere which can be obtained with a cyclorama and at the same time to show how it can be used in an imaginative manner without any attempt at producing natural phenomena. It is a debatable point as to whether such a modern design should be used in a Restoration play, although the actual result justified the experiment in this particular instance. In any case, the design itself, qua design, was generally considered excellent.

The lighting of the cyclorama was by green alone for the top portion and a mixture of red and blue at the bottom. The colour on the tree in the centre were brought out by spotting it with daylight blue.

This plate should be examined by daylight, but even then it gives but a poor idea of the actual purity and brightness of the colours.

Chapter IX

THE NEXT THEATRE?

I have heard it said that the theatre as we know it to-day is like a horse-cab in these days of taxi-cabs. I shall not attempt to compete with Mr. Bonamy Dobrée[1] in looking into the remote future. Let me rather try to indicate the change which we are likely to see in the immediate future from the horse-theatre to the taxi-theatre.

The present form of the commercial theatre has persisted for a long time because of the convenient manner in which portable scenery can be toured and fitted up in these buildings, by people with little or no special knowledge. This touring system seems to me to be on the wane, and in the near future I hope to see all the large towns supporting their *local* Repertory companies in homes that are really their own and with a resident producer and company. The lead was given by Miss Horniman at Manchester, and she was followed by Liverpool, Glasgow, and Birmingham.

The first amateur repertory company of real standing was the Maddermarket Theatre, founded by Mr. Nugent Monck at Norwich before the War.

After the War various amateur repertory companies were founded, such as those at Sheffield, Leeds and Newcastle, the Scottish National Players in Glasgow, the Unnamed Society at Manchester, St. Pancras People's Theatre, London, and the Welwyn Garden City Theatre. All these companies work under professional

[1] *Timotheus*, the future of the Theatre. By Bonamy Dobrée. To-day and To-morrow series. (Kegan, Paul.)

producers, some now have a nucleus of professional actors as well.

The post-war professional companies are represented by Bristol, Hull, Oxford, Cambridge and Northampton. Northampton is one of the latest additions to the list. Here a local group has taken a lease of the Opera House for the Northampton Players, for whom Mr. Herbert Prentice is now producing.

Not only are all these companies working in theatres which vary enormously in size and shape, but the newer theatres also vary in *design*. It is this fact of design, apart from the difficulty of size, which makes Mr. St. John Ervine's plan for an interchange of plays and players by provincial repertory companies impracticable. Oxford and Cambridge have, it is true, tried such an interchange, but the difficulties of scenery and lighting for a repertory of plays ranging from Greek tragedy to Expressionism and Constructivism do not justify the continuance of the experiment. Naturally those managements who are content to enact only those plays requiring a permanent scene throughout, or a few "box-sets" and the minimum of lighting, will not experience the same trouble.

I think we must look, at least in the provinces, for a multitude of small or medium-sized theatres (which are already springing up)—theatres with their own stock companies, producers, workshops, wardrobes, and technical staff. These will be professional, or mixed professional and amateur, and they will build to their own designs in every conceivable style.

The leaders of the newer movements in the theatre, both here and in America, are anxious to alter the form of the playhouse as well as to experiment with new forms of dramatic technique, taking advantage of light as one of the chief mediums of expression, and particularly aiming at a closer contact between the actors and the audience, the first step towards which seems to be the abolition of any kind of proscenium.

Mr. Terence Gray may be said to head the English

section and Mr. Norman-Bel Geddes the American. Mr. Geddes has very kindly supplied me with plans of his projected playhouse and a copy of a most interesting article by Mr. Claude Bragdon. (*Towards a new Theatre*. Published in the *Architectural Record* of September, 1922.)

Of those interested in the Art of the Theatre Mr. Bragdon says:—

"It is not their idea to abandon the present form of theatre altogether or all at once. The proscenium-frame theatre is (naturally) perfectly adapted to that dramatic form which has been adapted to it; but it is ill-suited to the presentation of Greek or Elizabethan drama, and to such plays as would give free range to the imagination of an author accustomed to the liberty afforded by the novel or even of the cinema. Least of all would the picture-frame theatre prove adequate for a new type of dramatic representation altogether—one which is shaping itself in the minds of those dedicated to the discovery of new possibilities of emotional expression in song, in mobile colour, in pantomime and in the dance. Some synthesis of all these elements—some inspired binding of them all together—might lead to a new art form: the art of the theatre *par excellence*.

To gain some idea of the grounds for the deep dissatisfaction with the existing (physical) theatre cherished by those who know it best, glance at it for a moment with their eyes. It is convenient, comfortable, even luxurious as to its auditorium—the box office side; but on the seamy side of the asbestos curtain there has been no substantial improvement, but rather retrogression from the theatres of an earlier day by reason of the saving of space made necessary by high building costs and increased ground rents. The stage has been made shallower; the floor trap, the painting bridge, the green-room have been eliminated; the dressing rooms have been crowded aloft, and, superimposed, are reached only by endless flights of narrow, noisy iron stairs. The many ingenious mechanical devices and felicities of operation and arrangement which have revolutionised European stagecraft (in its finer manifestations) and even influenced its drama, are completely unknown in the modern American theatre, wherein the comfort of the playgoer has been increasingly considered, but the convenience of all backstage functionaries, including the actors, has been considered less and less. To sum

it all up in a phrase, there has been no intention of consciousness upon the fundamental physical problems of the theatre from any other point of view than that of monetary gain.

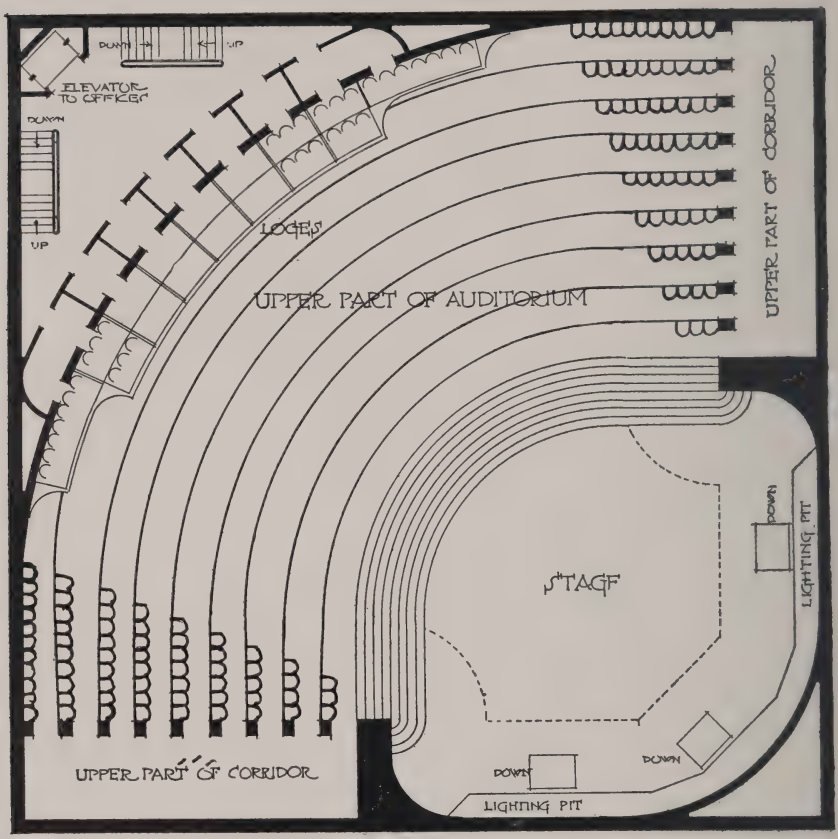
"Such being the situation, any new solution of the problem of the theatre building should be of interest, and the solution here presented has a unique importance, because it is the contribution of Mr. Norman-Bel Geddes, a man deeply immersed in the existing theatre, but at the same time deeply desirous of that other theatre which exists as yet only in the ardent dreams of those who feel the pressure of a beauty which is new. . . ."

In describing Mr. Geddes' design, Mr. Bragdon continues:—

"Because he does not seek to avoid, but rather to challenge comparison with theatres of existing type in this matter of profitable utilisation of space, Mr. Geddes assumes, for the working out of his scheme, a plot of ground one hundred by one hundred feet, with streets on two adjoining sides. He finds by this scheme, placing the stage in an angle instead of against one side of the square, he is able to seat more people than does the old-fashioned theatre of equal size. At the same time he gets a deeper stage, dispenses with balconies and galleries, and gives to each person nearly double the amount of floor space ordinarily allotted. All this is made possible because the main axis of stage and auditorium is along the diagonal of the square represented by the ground plan. That with which this type of auditorium has the closest affinity is perhaps the Greek theatre, with its seats arranged circle-wise in tiers. But in this modern instance the tiers are not intersected by any transverse aisles whatever; the actor faces an unbroken sea of faces. The entrances being from either side instead of from the back, each tier becomes an aisle for all those entering or leaving it, a thing made possible by the wide interval—four and a half feet—between one chair back and the next. By this arrangement every seat has plenty of 'leg-room,' and also commands an excellent view of the entire stage, none being too distant to be desirable, nor too high up or low down. There is no gallery and there are no boxes—only a single row of loges immediately above and behind the outermost tiers of chairs.

"Because this constitutes so radical a departure from the existing type of auditorium, it fails to conform to current building laws relating to theatres, but this does not mean that it would be

less safe under panic and fire conditions; there is every reason to believe it would be more so. Instead of being an aisleless

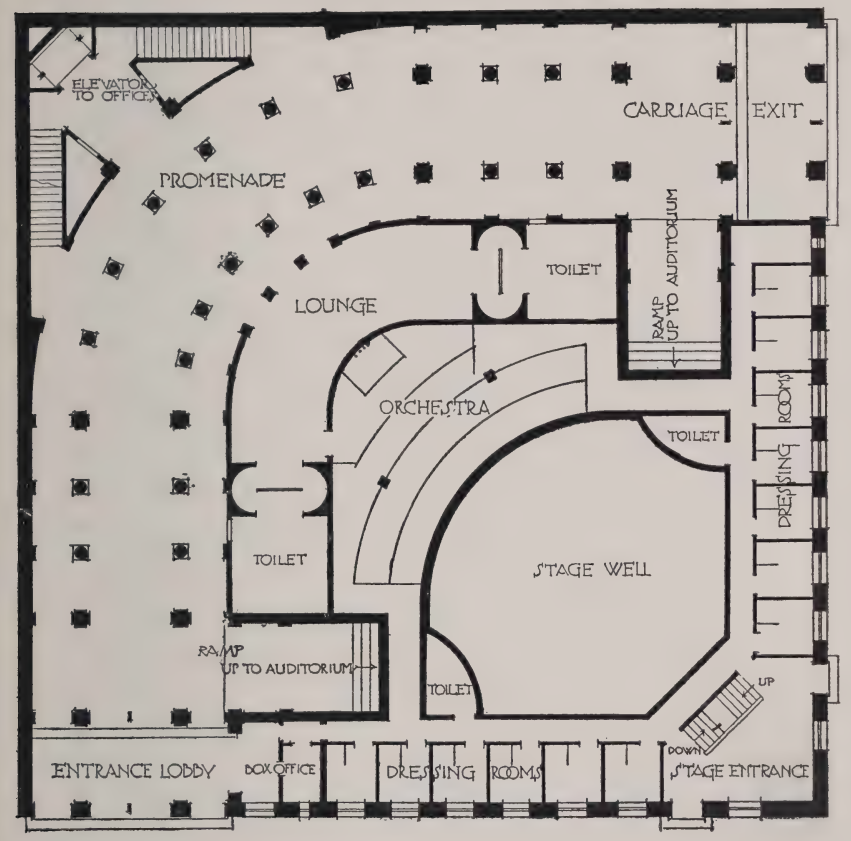


Plan through Loges.

Fig. 71.

theatre, as from the floor plan it appears (Fig. 71), it is all aisles, and these discharge into passageways two feet wider than the New York building law requires. The direction of the discharge

is gently downwards; the absence of a balcony, with its long flights of stairs, eliminates the greatest source of danger in case of panic,



Plan through Foyer.
Fig. 72.

while the absence of flies, gridiron, and an accumulation of scenery on and above the stage reduces the danger of fire.

"For in the stage and everything pertaining to it Mr. Geddes departs from precedent altogether. The stage is undivided from

the auditorium except for a flight of steps across its entire front, and two side jambs which lose themselves in the curve of the ceiling. The same great dome spans actor and spectator; there is no visible orchestra pit, no footlights, no proscenium arch, nor even a curtain between the two. . .

"Everything in the way of scenery is set on movable platforms deep underneath the stage — platforms which are capable of being shifted horizontally, and of being raised and lowered by hydraulic power; in their final position at the proper level they constitute the stage floor. There are two of these platforms, so that while one scene is being played the next is being set, the substitution being effected during a few moments of darkness, or behind a 'curtain of light.' In this way scene could be made to succeed scene with no descending guillotine of a curtain to cut off the actors' heads, and by a diversion of attention break the spell.

"The major part of the space underneath the auditorium is occupied by a broad quadrant-shaped foyer, extending from one entrance to the other—an ample promenade, which by reason of its great curved colonnade could not but be architecturally impressive. (Fig. 72.) The remaining room between the foyer and the stage on this level is occupied by the orchestra, which is entirely concealed from the view of the audience, the sound reaching the auditorium through perforations in the risers of the continuous flight of steps which forms the apron of the stage. This room is large enough to accommodate an orchestra of 60 musicians; the conductor commands a view of the stage through a large periscope.

"The dressing rooms are also on this level; they occupy the space underneath the outside edges of the stage, which being adjacent to the streets give each dressing room outside light and air.

"Immediately behind and below the rear of the stage is a passage-way or ante-room for actors, connected with the stage proper by means of three stairways, the wells of which are capable of being closed by electrically-controlled traps. Behind this ante-room—between it and the main wall—is a light pit wherein are concealed lamps and projectors which reflect light upwards on the dome, for sky effects.

"Below the individual dressing rooms on the foyer level are others for supernumeraries and chorus. The basement is one vast and lofty chamber with a broad gallery midway in its height, on all four sides. This is for use as a work-shop.

"All scene changes are made in the basement, as has been said. Consequently it is here, where there is plenty of room, that all scenery and properties are stored. The stage, when lowered,

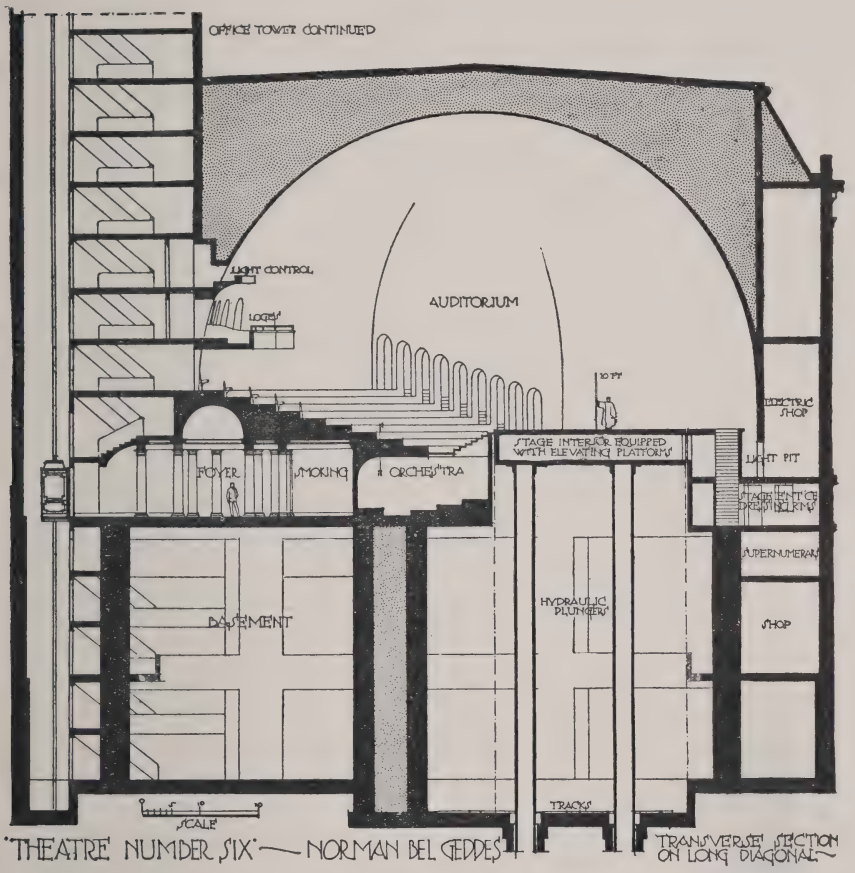
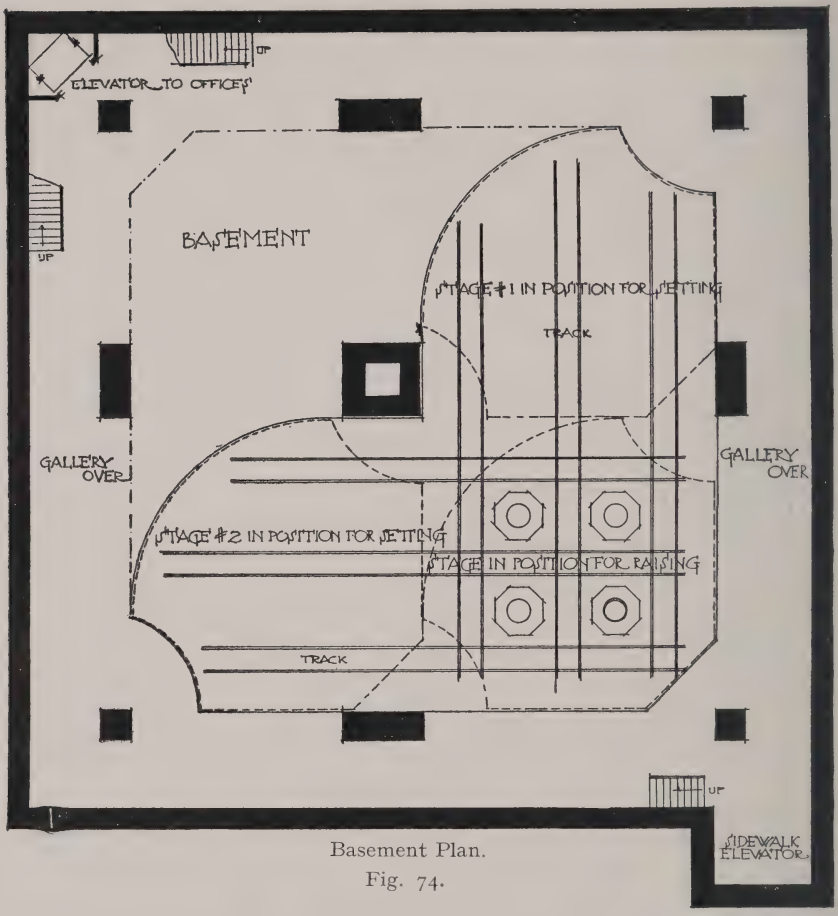


Fig. 73.

descends into a shallow pit which brings its floor level with the basement floor. There it is substituted for its fellow, all set ready for raising. The manner in which this substitution is effected will be best understood by referring to the section (Fig. 73), and the basement plan (Fig. 74). The platforms are carried from their original position, at right angles to one another, a distance equal to their diameter, on tracks set in the floor of the

pit. All this shifting and raising is under electrical control, and is accomplished noiselessly and quickly (the entire transfer would occupy only twelve seconds) for the mechanical problems involved, though unusual, are neither difficult nor new.



Basement Plan.

Fig. 74.

"To the eye and mind accustomed to the candy-box style of theatre design and decoration—a style inherited from a time when theatre-going was an amusement of the Court rather than the absorbtion of the populace—the stark bareness and austerity of Mr. Geddes' interior may come as something of a shock. But a moment's reflection should convince the unprejudiced that Broadway is wrong and he is right. . . .

"But because this theatre is bare it does not mean that it is therefore lacking in beauty. Indeed its very bareness—the unbroken sweep of the dome—gives an unequalled opportunity for beauty of a new and thrilling sort. The beauty of changing coloured light — colour-music if one chose to make it so—that art of the future of which Wilfred's Clavilux gave us the first actual intimation, showing what coloured light might become when dissociated from all those ideas of corsets, chewing gum, automobile tyres, et cetera, with which the zeal of the advertiser has succeeded in linking it up.

"And this brings me finally to the subject of lighting. Mr. Geddes' lighting arrangements differ in important respects from those in current use; for though the development of lighting has proceeded more rapidly in the theatre than anywhere else, the equipment on which this development in part depends has not kept pace with the advance. But now that light is coming to be recognised as an emotional language, like music, with power to induce and maintain moods of the soul—this will not do. Light must be made to pale or brighten, it must slowly transform itself from warm to cold, and from cold to warm, changing key and tempo as it were, in sympathy with what is passing on the stage. To achieve these effects successfully—and many others, more intricate by far—it is imperative that the light operator should work from a compact keyboard, and in full view of the auditorium and stage.

" These are the reasons why, in this theatre, the light control is located in a little booth above the loges, behind and above the heads of the spectators and concealed from them, the projectors being on disappearing carriages, hidden by a parapet save when in actual use. Here the light operator sits, remote, unseen, like the organist in the choir-loft of a cathedral, learning to master an art which may usher the human spirit into realms at which music itself now beats in vain.

" It should be stated that a theatre of this type—with scene and actors thrust forward into the auditorium instead of being kept behind a proscenium picture frame—is practicable and desirable largely by reason of the advancement in the use and control of artificial light. Nothing so distinguishes the most modern stagecraft from that of only a few years back as the new uses to which light is put and the extraordinary functions it is made to perform. Scene changes can be made in utter darkness with the curtain up, or behind a 'curtain of light,' objects can be

made to reveal themselves, conceal themselves, transform themselves by the combined use of light and pigment, scientifically worked out. 'Painting with light' is not simply a catchword, but a phrase with an ever-expanding content. By the use of lenses light can be so concentrated and controlled that 'masking' of the old-fashioned sort—concealing by means of curtains, flats, borders—is no longer necessary; darkness can be made to obliterate and light to reveal whatever is desired.

"In the theatre we do not want to feel that we are *at* a play, but that we are *in* it. . . ."

It will be noticed that Mr. Geddes in his efforts to secure intimacy has not gone to the length of introduring his actors into the auditorium, as there are no gangways leading to the stage itself. This practice is, I think, one to be used very sparingly, and many modern producers seem to me to have defeated their own ends by excessive and indiscriminate use of the auditorium. Although the audience may be made to feel they are *in* the play, nobody in full possession of his senses can be expected to believe that he is actually *taking part in the play*. Possibly a half-wit might be tricked into such a state of mind, but it is absurd to attempt such childish deception upon an intelligent theatre-goer. All attempts at this at the Festival Theatre have, to my mind, proved disastrous, although there have been moments when exits and entrances through the audience have been technically correct and dramatically effective. As a general rule the auditorium can be used much more freely in comedies and plays requiring an atmosphere of intimacy between actor and audience than in dramatic plays which need a tense atmosphere of illusion. Nevertheless, perhaps the most magnificently effective moment in the Festival production of "The Oresteia" was when the furies rushed through the audience to haunt Orestes. But it is important to note that the entrance was a very rapid one. It was all over in a moment or two, and the audience had only time to catch the atmosphere of excitement without having time to study the actors

at close quarters. On the other hand, in "Oedipus" the attempt to make the spectators feel like citizens of Thebes during long dialogues between actors on the stage and at the back of the auditorium failed hopelessly. It is highbrow snobbery of the worst kind for anybody to pretend that his imagination is so keen that he can see an actor in Grecian robes standing in the stalls among an audience in dinner jackets and feel no sense of incongruity. However, we may make this exception to our rule and say that in serious or realistic plays the auditorium may be used for very rapid, brief, and dramatic entrances and exits, but never for the delivery of actual speeches, though messengers coming from a distance can be safely introduced into the action from the front-of-the-house. This was done with specially good effect in the Festival production of "Richard III."

In comedies and very light plays there are obvious advantages in creating an atmosphere of intimacy and good fellowship between stage and audience by means of mingling actors and spectators. In "Androcles and the Lion," for example, the lion made his first entrance by limping his way through the stalls, and later on when he leapt upon the stage and scattered the terrified Christians they fled into the auditorium. Two other plays produced at the Festival which gave opportunity for legitimate and most successful use of the auditorium were "Each in his Own Way," by Pirandello, and Beaumont and Fletcher's "The Knight of the Burning Pestle."

The use of the auditorium by the actors means that it must be illuminated as well as the stage, with results which are irritating and distracting to the audience who can see one another as clearly as the actors. The maximum amount of concentrated dramatic effect is always obtained when the audience is in total darkness and can see nothing beyond what is taking place on the acting-area, although in London it is an effect which it is impossible to achieve owing to the utterly ridiculous number of safety lights in the auditorium insisted upon by the London County Council.

Chapter X

COSTUME, SCENERY AND MAKE-UP AS AFFECTED BY COLOURED LIGHT

At the risk of stating the obvious I would point out that costumes should be chosen for the lighting, or the lighting arranged for the costumes, whichever is of most importance in the play under consideration. Usually the whole matter is left to chance. The same remarks apply to the painting of scenery.

The following table gives a general idea of the effects of coloured lights on pigments and materials, but it must be remembered that the chemical compounds used vary greatly without giving any indication of this to the eye until coloured light is substituted for daylight. Also few mediums are theoretically pure filters. The mediums referred to by number are Messrs. Digby's. (See list at end of book.)

KIND OF LIGHT.	EFFECT ON MATERIALS AND PIGMENT.
Gas-filled lamps.	Approximately true colours. Coldish general tone.
Vacuum lamps, or gas-filled with No 17.	A warmer general tone than above, as the light is yellower. Slight tendency to loose the brilliance of blues and greens, but no change of colour.
Daylight. Arcs and gas-filled with No. 10.	True colours. Not used as much as might be expected because of the hard cold atmosphere produced.

KIND OF LIGHT.	EFFECT ON MATERIALS AND PIGMENT.
Gas-filled lamps with the following:— No. 17 Straw.	(See above) No. 17. Used for toning down the harshness of arcs or gas-filled lamps with very little loss of light. Useful for full sunshine effect.
No. 19. Middle straw.	Deeper than No. 17. Dulls blues and greens. Often used with No. 5 for acting area lighting when a cheerful atmosphere is wanted.
No. 20. Middle pink.	Rich colour useful where No. 3 is too violent in its action. Bad for greens.
No. 3. Dark amber.	Completely spoils blues and greens. Poor for reds. Good for orange, yellow and pink. Frequently used for acting-area lighting where the costumes are suitable or when their change of colour does not matter, as in night scenes (torchlight, etc.)
No. 4. Salmon red.	Bad for blues and greens. Darkens pinks, orange and yellows. Rarely used for acting-area light.
No. 7. No. 8. Light and dark red.	Bad for greens, poor for blues. Good for reds (see contrast below). Turns yellows orange or red.
No. 9. Magenta.	An exceedingly useful vivid colour. Used occasionally in spots and focus-lamps to bring out blues and purples on costumes and scenery. Has a wonderful "deepening" effect when used in conjunction with other acting-area lights. All light colours are naturally swamped completely.
No. 16. Violet.	Effective because of its vividness. Spoils most colours as such, but frequently produced a new colour which is pleasing, as in the case of greens. Good for reds.
No. 5. Light pink.	Good for all colours except greens. Tends to darken blues. Gives a warm, pleasant tone to the stage. Greatly used for all purposes.

KIND OF LIGHT.	EFFECT ON MATERIALS AND PIGMENT.
No. 6. Dark Pink.	As No. 5, but more pronounced effect. Blues turn purple and greens blue.
No. 21. Salmon pink.	See No. 5.
No. 10. Steel blue.	(See under arcs and daylight.) Gives artificial daylight with gas-filled lamps. If there is not too much movement on the stage, costumes that otherwise would be spoilt can be saved by spotting with No. 10.
No. 18. Middle blue.	A useful blue for many purposes. Spoils no colours and improves some.
No. 24. New blue.	Between 18 and 12. Darkens some reds.
No. 12. Dark blue.	Fairly good with all colours. Extensively used for general lighting of night scenes. Tendency to turn reds black.
No. 22. Purple.	Bad for greens. Good for reds and blues.
No. 13. Moonlight green.	Good with nearly all colours, especially greens, which are improved. (See contrast below.)
No. 15. Dark green.	Spoils nearly all colours except green. Never used for acting-area.

Contrast. Mistakes are often made with the more vivid colours because the question of contrast is not taken into consideration. Thus one hears that reds go dull under red light, or that greens disappear under green light. Generally speaking, colours remain the same under light of their own colour but do not always show to advantage. A simple experiment will demonstrate this.

Take a piece of scarlet material and put it against a black background. It looks well under daylight or red light because there is always contrast. Put the same material on a white background, and as soon as red light is turned on, it will disappear, because everything is then red and there is no contrast. If blue-green light is now turned on, the red material goes black on a green background (complementary colours).

This principle was made use of in the well-known "Samoiloff effect" used on the music halls, where the scenery and actors' clothes were made to change mysteriously by the alteration of the lights, white people being turned black and vice versa.

It will be seen that, in general, deep yellow light should be avoided where blues and greens are much used; and while pink is harmless, red light must be avoided for the same reason. The alternative is to have a colour scheme which does not include blues and greens, or to use no coloured light and rely on the *decor* alone.

The blues will be fairly safe except for reds.

With the old-fashioned lighting, make-up was very necessary for all actors, particularly to neutralise the high lights under chins and noses and in the eye sockets, caused by the brilliant glare from the footlights. It must be remembered too that the colour of the light has varied very much from time to time when passing from candles to oil, gas, incandescent-gas and electric light. With modern lighting the use of heavy make-up is gradually disappearing except where demanded in any particular character part. In playing straight parts the modern actor frequently adds a touch or two to the eyes and no more. In some cases where special lighting is used, fairly heavy make-up may be required, and this can only be settled at rehearsals with the lights actually to be used. Modern dressing rooms should be fitted with lanterns over the dressing-tables so that the colours actually to be used on the stage may be employed by the actors when making up.

Of the colours most frequently used for the acting-area, blues give the greatest trouble, as they turn carmine grease paint and dry rouge black. If the blue light is used for a complete scene, it is easy to omit red from the make-up and put in on for a subsequent scene if necessary.

Very little advance has been made in the manufacture of grease-paints and the old flesh-tints from 1 to $3\frac{1}{2}$ are not suitable for modern lighting. Leichner now sell three flesh tints more suitable, under the rather humourous names of "Star Girl," "Star Lady" and "Star Madam."

Floats tend to bring out make-up. When not using floats the make-up must be heavier.

Gelatine Mediums, 22 inches × 17½ inches, as supplied by Thomas J. Digby, 12, Gerrard Street, London, W.1.

No. 1. Yellow.	No. 13. Moonlight Green.
,, 2. Light Amber.	,, 14. Light Green.
,, 3. Dark Amber.	,, 15. Dark Green.
,, 4. Salmon.	,, 16. Violet.
,, 5. Light Pink.	,, 17. Straw.
,, 6. Dark Pink.	,, 18. Middle Blue.
,, 7. Light Red.	,, 19. Middle Straw.
,, 8. Dark Red.	,, 20. Middle Pink.
,, 9. Magenta.	,, 21. Salmon Pink.
,, 10. Steel Blue.	,, 22. Purple.
,, 11. Light Blue.	,, 23. New Green.
,, 12. Dark Blue.	,, 24. New Blue.

Thick Frost for flooding.
Thin frost for general projection.
Focus frost for focussing.

American Technical Terms.

These differ very little from the English, with the following exceptions:—

Blinder.	Mask.
Boomerang.	Colour magazine.
Border or border lights	is the term used in America for our battens.
Dutchman.	Condenser attachment on focus-lamp or spot. This term is also used in quite a different connection by stage carpenters.
Olivette.	Open flood box.
Pockets *Outlets.*	Plug sockets.
Sciopticon.	"Effect" projector.
Strip lights.	Lengths.

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* Strongly recommended. Makes a companion volume to *Stage Lighting or "Little" Theatres.* By C. H. Ridge.

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